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SCHOOL MATHEMATICS STUDY GROUP REPORT NO. 2, THE SPECIAL CURRICULUM PROJECT: PILOT PROGRAM ON MATHEMATICS LEARNING OF CULTURALLY DISADVANTAGED PRIMARY SCHOOL CHILDREN.

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The purpose of this study was to determine the effectiveness of existing School Mathematics Study Group (SMSG) materials in developing materials for teachers emphasizing techniques for providing disadvantaged children with experiences necessary for the formation of the fundamental concepts of arithmetic. In this experiment, six kindergarten and seven first grade classes in disadvantaged areas of six cities were tested at the beginning of the 1964-65 school year. In addition, two classes at each of these grade levels, but from high socioeconomic areas were tested as were one kindergarten class and one first grade class using course materials other than SMSG. Most of these classes were followed throughout the school year, with individual tests being administered at three points. Classroom observations, teacher reports, and a group test administered at the end of the school year provided other kinds of data. Variability in performance with in the disadvantaged classes was shown to be consistently very large. Variability between classes of disadvantaged children was also found with regularity. The changes in performance of the disadvantaged kindergarten children over the year were, on many of the tests, different from those changes observed in the first grade children. (RP)

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SCHOOL
MATHEMATICS
STUDY GROUP

SMSG REPORTS

No. 2

The Special Curriculum Project: Pilot Program on Mathematics Learning of Culturally Disadvantaged Primary School Children

Gloria F. Leiderman
William G. Chinn
Mervyn E. Dunkley

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William G. Chinn
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Financial support for the School Mathematics Study Group has been provided by the National Science Foundation.

The study reported here was directed by a committee listed in the final appendix to this report. In the same appendix is a list of the participating teachers.

The Project Coordinator during 1964-1965 was Mr. Mervyn Dunkley. He carried out some of the preliminary statistical analyses of the study and prepared first drafts of a few sections of this report before returning to his permanent position in Australia in August, 1965.

Mr. William Chinn, who was Project Coordinator for a follow-up study in 1965-1966 (for which a report will be prepared), was responsible for most of the statistical analyses reported here and provided editorial consultation during the preparation of the report.

Dr. Gloria Leiderman, the senior author of this report, was associated with the study as a Research Associate from its inception and participated in all its phases.

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I INTRODUCTION

This report is the first in a series which will be issued periodically to present the findings of the SMSG Special Curriculum Project. The contents of this first report include the purpose of the study, procedures utilized, and discussion of preliminary data analyses.

The Special Curriculum Project resulted from a Conference on Mathematics Education for Below Average Achievers sponsored by SMSG in Chicago, Illinois, on April 10 and 11, 1964. Through the interest of the Cooperative Research Branch of the U. S. Office of Education, funds were made available by the Office of Education for this conference. Position papers were presented for discussion at the conference, and a panel of mathematicians were asked to react to the papers and to the discussions. The participants then met in four groups, each devoted to a particular area of concern. These areas were:

Schools in the slum areas of the great cities
Segregated Negro schools
Mathematics for the unemployed
Mathematics programs for students of low ability

Recommendations of the four groups were discussed at a plenary session, circulated to all participants for comments, and incorporated in the published report of the conference.[1]

At the time that SMSG turned attention to children not achieving well in mathematics, it was quickly realized that a large percentage of children from culturally disadvantaged homes fall within this group. It was further realized that the greatest hope for breaking into the spiral of cumulative failure lay in starting work at the beginning school years. Thus, the Special Curriculum Project was planned to study the readiness of disadvantaged children to learn at school entrance and to follow their progress over the early school years with the purpose of developing more effective materials for their continued and, hopefully, successful learning of mathematics.

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[1] School Mathematics Study Group, Conference on Mathematics Education for Below Average Achievers, Stanford, 1964.

II PURPOSE OF THE STUDY

On the basis of recommendations of the SMSG Ad Hoc Committee on Below Average Achievers in Mathematics, observation classes at the kindergarten and first grade levels were established for the 1964-65 school year. These classes were located in densely populated cities and were composed of children who could be described as economically and culturally disadvantaged. The purpose of this study was to determine the effectiveness of existing SMSG materials in developing "materials for teachers emphasizing techniques for providing disadvantaged children with experiences necessary for the formation of the fundamental concepts of arithmetic."[2]

This study was based on the assumption that there is a differential in school-related experiences prior to school entrance between advantaged and disadvantaged children. Studies from a number of sources suggest that children from more advantaged homes have had experiences of greater variety in an organized family setting than do children in disadvantaged homes. By the time the more advantaged children reach school-age, they appear to be better able to work in a group situation, to utilize verbal skills, and to deal with abstract concepts.

Children from disadvantaged groups seem to lack many of the experiences which facilitate school learning. The absence of books, of set family routines, of enough possessions for sharing to occur, and of encouragement to verbalize, are some of the factors which contribute to decreased adaptation to the classroom and increased difficulties in learning.

Two major criteria used in identifying people classified as culturally disadvantaged are low economic status and lack of participation in middle class culture. The actual income may vary from one study to another. A maximum family income of $2,000 per year specifies the disadvantaged in some studies; an income below $4,000 per year in others.

The criterion of lack of participation in middle-class culture is more difficult to specify, but relates closely to the values placed upon education. The lack of books, of parental examples of reading and success in education, and the lack of stimulation to achieve, are all parts of this nonparticipation in middle-class culture.

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[2] Recommendations of SMSG Ad Hoc Committee on Below Average Achievers. The report of the Ad Hoc Committee appears in Appendix A, page 91.

III PROCEDURES

The cooperation of a number of school systems throughout the country was obtained to permit SMSG to use its existing books in kindergarten and first grade classrooms. Play materials were also provided in each classroom and were used to help develop mathematical concepts which the children had difficulty understanding in more verbal and abstract form. SMSG further made provision for mathematical consultants and center coordinators to work with the teachers. The centers involved in the 1964-65 study were located in Boston, Chicago, Detroit, Miami, Oakland (California), and Washington, D. C.

Designation of the particular schools in the disadvantaged areas of each city, as well as the selection of teachers experienced in working with young children in these areas, were made by the local school system.

The teachers made weekly reports describing and evaluating their daily mathematics lessons and following the progress of individual pupils. They prepared reports on each chapter of the SMSG books as they completed the material. The teachers also met, as a group, with committee members of SMSG four times during the school year to discuss progress, report difficulties, and to recommend modifications of the existing SMSG text materials.

Two other sources of evaluation data were classroom observations at periodic intervals, and testing of the children in each class. The testing program consisted of individual tests given at the beginning, middle, and end of the school year, plus a group test administered at the end of the school year. The present report will be concerned primarily with the initial analyses of the individual test findings.

IV DESCRIPTION OF THE SAMPLE

A. Experimental and Comparison Groups

It was the plan of this project to follow the progress of children in the experimental classes throughout the school year. Comparisons of performance to children not in the experimental classes were also planned. The first comparison was to children at the same grade level who were from more advantaged homes. For this comparison, two classes at the kindergarten and two at the first grade level from middle class neighborhoods of the metropolitan areas used for the experimental classes were included in this pilot study. These classes used the same SMSG materials as did the experimental classes.

The second comparison was to be made on curriculum. It was planned that the one kindergarten and one first grade comparison class would be of the same socio-economic group as the experimental (disadvantaged) classes but would use a curriculum different from SMSG. The classes actually obtained for this comparison were located in the same area of the city as some of the experimental classes but were of a somewhat higher socio-economic parent population. These comparison classes used the local school district elementary mathematics curriculum.[3] This curriculum starts with the numeration system, rather than with the concept of set as does the SMSG curriculum.

B. Demographic Characteristics

In order both to describe the sample and to determine whether differences could be observed in the learning of children with different experiential backgrounds, e.g., intact or broken homes, or children with preschool experience compared to those with none, an effort was made to collect demographic data on each of the children. Since the policy on releasing such information varies from one school system to another, it was not possible to collect such information on every class within the sample.[4]

The racial composition of the classrooms within the experimental group varied from classes composed of all Negro children to two first grade classes split about equally between Negro and Caucasian. The middle-class comparison kindergartens and first grades were composed of almost all Caucasian children, while the one curriculum comparison kindergarten and first grade were composed of almost all Negro children. There were a few classes in which one or two children were of Chinese or Mexican parentage, but none of the classes contained a significant percentage of these groups.

Each teacher was requested to obtain information on her pupils on such items as child's birthdate, whom the child lives with, age and sex of siblings, any recorded test scores, and the child's previous school experience.

---

3. Public Schools of the District of Columbia, Elementary Mathematics Curriculum. Washington, D. C., 1960.

4. For a copy of the background information form, see Appendix B, page 93.

TABLE 1

WITH WHOM THE CHILD LIVES

	Kindergarten		First Grade	
	E	C	E	C
Mother only	54	2	52	2
Father only	1	0	2	0
Both Parents	107	21	102	22
Other (e.g., grandmother)	1	0	12	0
Total No. of Pupils	163	23	168	24
Total No. of Classes	5	1	6	1

It should be noted in reading Table 1 that data were available on only one of the three comparison classes at the kindergarten and one at the first grade levels. These are both socio-economic comparison classes. For the experimental group, this table is based on five of seven kindergarten classes and six of eight first grade classes.

What is immediately apparent in scanning this table is the difference between the experimental and comparison groups in the percentage of children living in intact family groups, i.e., with both parents. When these figures are converted to percent, 66% of the kindergarten and 61% of the first grade experimental children were, at the time of this study, living with both parents while 91% of the kindergarten and 92% of the first grade comparison class pupils were living with both parents.

A typical index of socio-economic status utilizes the occupation and education of the father. Information on education of parents was not available to the teachers; only the coding of information on occupation was possible. From the descriptions, fathers' or guardians' jobs were classified into categories of unskilled, semi-skilled, skilled, or professional work. In those instances where the child lived with the mother only, a question on whether the mother was receiving Aid to Needy Children was included.

TABLE 2

OCCUPATIONAL CLASSIFICATION OF FATHERS

	Kindergarten		First Grade	
	E	C	E	C
Unskilled or semi-skilled	75.6%	68.2%	80.0%	62.5%
Skilled or professional	9.2%	31.8%	5.1%	37.5%
Father/Guardian Unemployed	7.0%	0.0%	6.4%	0.0%
Mother Alone: Receiving ANC	8.2%	0.0%	8.5%	0.0%
Total No. of Pupils	159	22	149	24
Total No. of Classes	5	1	6	1

The entries in the first two rows of Table 2 show the occupational classification of fathers of pupils for whom such information could be obtained. The entries in the rows entitled "Father/Guardian Unemployed" and "Mother Alone: Receiving ANC" were necessary to cover those families in which the father was not present, or was currently unemployed, and no occupation was given.

It can be seen that a considerably higher percentage of fathers of the comparison pupils fall into the "Skilled or Professional" category than do fathers of experimental class pupils. It can also be observed that there are no families in the comparison groups where the father was recorded as being unemployed. In addition, although there were a small number of children in the comparison classes living with mother only (see Table 1), none of these families was recorded as receiving public welfare assistance.

Of the six first grade experimental classes for whom data were available on kindergarten attendance (N = 151), 90.1% had attended kindergarten. For the first grade comparison class (N = 24), 100% of the children attended kindergarten. A noteworthy observation on previous school experience concerns the number of children in the experimental group who were repeating first grade. In two of the six experimental classes, no children were reported as repeating; in a third class, there was one child repeating first grade. In the other three experimental first grades, however, there were, respectively, five, seven, and ten children repeating first grade. In the one comparison first grade class, one child was repeating.

V PUPIL TESTING PROGRAM

A. Individual Tests

Individual tests were developed to minimize whatever differential might already exist between the disadvantaged and more advantaged children in skills related to test-taking. The tests that were devised contained manipulable materials in almost every item. The children's responses were, thus, made to concrete objects rather than to printed materials where possible. The verbal directions given by the tester were kept to simple statements, and the few verbal responses expected of the children were brief.

These individual tests were administered in October, January, and May. They were introduced to each child as games, and an attempt at establishing rapport with the child was made by the tester before beginning the assessments.

Table 3 presents the concepts measured at each of the three individual testing sessions. The entry "X" in the table indicates that that concept was tested in the particular inventory.

In the results section to follow this description of the testing, the presentation of results will be in the order: Initial, Midyear, Final Inventories with each assessment presented in the sequence given in Table 3.

TABLE 3

SCHEDULE OF ASSESSMENTS: INDIVIDUAL TESTS BY GRADE

Assessments Made	Initial		Mid-Year		Final	
	K	1st	K	1st	K	1st
Recognition						
Objects	X	X				
Photographs	X	X				
Drawings	X	X				
Vocabulary			X	X		
Visual Memory						
Objects	X	X			X	X
Pictures					X	X
Color Inventory						
Matching	X	X				
Naming	X	X			X	X
Identifying	X	X			X	X
Geometric Shapes						
Matching			X	X		
Naming			X	X	X	X
Identifying			X	X	X	X
Pairing				X		
Equivalent Sets			X	X		
Counting						
Buttons	X	X	X	X	X	
Members of a Set			X	X	X	X
Rote	X	X			X	X
Rote by Tens						X
Number Symbols						
Identifying	X	X		X	X	X
Naming						X
Marking	X	X		X	X	X
Place Value						
Naming						X
Forming						X
Ordinal Number					X	X
Ordering			X	X	X	X
Classifying			X	X	X	X

The initial inventory was planned as an evaluation of readiness of the children to learn mathematical concepts. This readiness is dependent upon experience and development in many areas. If the child is to learn to abstract and conceptualize from experience with concrete materials, it is important to ascertain whether he can recognize, by giving names to, the concrete materials being used. Also, since color is an important classificatory principle in the early school years, it is important to learn whether the children can perceive and match the same hues, name the colors, and identify an object whose only property differentiating it from the others in the series is its color.

Two other facets of cognitive development were assessed. The first was the ability of the child to make a transition from recognition of a concrete object to recognition of a photograph of it, and then to a line drawing of that object. The second was one kind of mediating response: visual memory. The progression from concrete to conceptual thought, upon which mathematical learning is based, requires the child to be able to form mental representations of objects he has previously seen but which are physically absent. Therefore, the visual memory assessment was used.

Assessment of performance on tasks more directly mathematical in nature included counting, recognition of numerals, ordinal number, and ordering objects by size, as well as classifying them by shape and color.

It will be noted from inspection of Table 3 that a number of the assessments made in the initial testing were repeated or extended in the testing sessions to ascertain growth through the school year.

B. Group Test

In addition to the individual tests, a group paper-and-pencil test was administered to the children at the end of the school year to measure proficiency gained through the year in number, mathematical concepts, mathematics vocabulary, and following directions. The assumption was that, although these pupils could not have performed well in a group situation with a paper and pencil instrument at the beginning of the school year, a reasonable estimate of their performance level could be made under such circumstances at the end of the year.

To ensure that all of the children understood what was expected sufficiently to proceed with the test, each class was split into groups of about eight children for its administration. Directions for each item were read to the children by the teacher.

VI RESULTS AND DISCUSSION: INITIAL INVENTORY

1. Recognition: Objects, Photographs, Drawings

In this assessment, the pupils' ability to recognize objects commonly used by teachers as curriculum materials in the primary grades was measured. In addition to the concrete objects, recognition of photographs and line drawings of some of these objects was also tested. The reasons for including such a test are two-fold. First, "labeling" or naming of objects used in teaching is a basic pre-requisite for the child to be able to learn. If a child is severely experientially deprived, he may not know the names for such items as crayons, clock, book, various animals, and fruit.[5] In this instance, the teacher will have to start teaching such labels before their use in the teaching of concepts or solving of problems based on them can be started.

The second reason for including a recognition assessment is that a certain progress in development must occur for a child to be able to recognize a representation of an object. In order to be able to handle printed or workbook materials, the child must recognize, for example, that a given set of lines on a paper represents a truck, another set a ball. The child's ability to make such a transition was measured by using photographs as an intermediate point between the concrete object and a line drawing of it, since the photograph provides many more details and, therefore, more perceptual cues than does the drawing.

The procedure for the Object Recognition was to place an object in front of the child and ask him, "What is this?" If the child's immediate response was not correct, he was asked, "What else could it be?"; "Is it like something else you know?"; and finally, "Do you know what it is used for?" Responses other than an immediate correct response were coded in the following manner:

- Qualified correct
  - gives class rather than name (e.g., animal for cow)
  - gives function, but not correct name
  - gives specifics or describes details, but not correct name
  - gives object within same class, but not correct name
  - gives incorrect name, then changes to correct name
- No response, or I don't know
- Incorrect response.

---

[5] A list of the objects used is included in the compilation of tests, Appendix C, page 97.

TABLE 4

OBJECT RECOGNITION: Initial Inventory

Kindergarten	Experimental Classes							Comparison Classes		
								Socio-Economic		Curriculum
	a	b	c	d	e	f	g	a'	f'	g'
N of Pupils	19	15	44	27	28	25	27	28	23	27
Range: Correct Responses	14-22	17-22	15-22	17-22	18-22	17-22	15-22	17-23	13-23	19-22
Mean	19.53	19.60	20.64	20.78	20.57	20.52	19.78	20.18	20.87	20.70
S. D.	2.21	1.50	1.61	1.37	1.24	1.27	1.89	1.73	2.36	1.15

Possible Correct = 23

TABLE 5

OBJECT RECOGNITION: Initial Inventory

First Grade	Experimental Classes								Comparison Classes		
									Socio-Economic		Curriculum
	A	B	C	D	E	F	G	H	A'	G'	H'
N of Pupils	35	34	25	24	25	28	25	19	31	24	24
Range: Correct Responses	16-23	18-22	16-23	18-22	16-22	19-23	18-22	19-22	18-23	19-23	19-22
Mean	20.51	21.06	21.24	21.00	21.16	21.39	21.20	21.26	20.97	22.21	21.58
S. D.	1.44	0.97	1.36	1.26	1.57	0.82	1.10	0.78	1.23	0.76	0.70

Possible Correct = 23

In Tables 4 and 5 above, the correct responses of the experimental and comparison groups on the Object Recognition test are presented. The findings in these tables and in those to follow are given, first, as individual class performance means. These tables will be followed by tables presenting differences between the experimental and comparison group sample means.

Inspection of Tables 4 and 5 above shows little difference between the individual experimental and comparison classes on this particular assessment. The question raised about disadvantaged children being able to label objects commonly used in primary curriculum materials seems to be answered in the affirmative.

It should be made clear that this Object Recognition assessment tests a very limited aspect of language. The fact that so many of the children could give names to these objects suggests that, at least on this particular dimension of language, the disadvantaged children were starting at about the same level as were the more privileged children (comparison classes A' and G')

TABLE 6

DIFFERENCES BETWEEN SAMPLE MEANS
ON OBJECT RECOGNITION: Initial Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-econ. Comp.	Curric. Comp.			
Kindergarten	20.310		20.700	185, 27	-1.229	n.s.
	20.310	20.491		185, 51	-0.677	n.s.
		20.491	20.700	51, 27	-0.493	n.s.
First Grade	21.073		21.580	215, 24	-2.009	n.s.(.05)
	21.073	21.511		215, 55	-2.440	n.s.(.02)
		21.511	21.580	55, 24	-1.078	n.s.

In Table 6, above, means for the experimental and the two comparison samples are given along with the significance levels of the values of t[6] for the Object Recognition assessment. The kindergarten findings support the discussion of individual class means, i.e., that the disadvantaged kindergarten children are not significantly different from the comparison groups on naming of objects.

Differences between the first grades as shown in Table 6 are found although they do not reach the .01 level of confidence. We have accepted as significant for this study only those findings that achieve the .01 level of probability since these are newly-developed tests and since our comparison samples are small. The direction of differences for the first grades indicates, however, that the disadvantaged children do not perform as well as do the curriculum comparison children ($p < .05$) or as well as the socio-economically more advantaged first graders ($p < .02$) on this test of language.

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[6] For an explanation of the t as a significance of difference test, see Lindquist, E.F., Design and Analysis of Experiments in Psychology and Education, Boston: Houghton Mifflin Co., 1953.

As the difference in frequency of correct names given by the experimental and comparison classes was small,a more detailed look at the breakdown of both "qualified correct" and incorrect responses seems useful in understanding qualitative differences in this verbal labeling. Table 7 presents, in percentages, the correct, qualified correct, and incorrect responses on the Object Recognition assessment of two kindergarten and two first grade classes, one experimental and one socio-economic comparison class at each grade level, within the same metropolitan area.

TABLE 7

OBJECT RECOGNITION: Initial Inventory
Coding of Responses for Four Classes

		Correct Responses	Qualified Correct	No Response or I Don't Know	Incorrect Responses
Kindergarten	Experimental N = 25	85.6%	10.1%	2.4%	1.9%
	Comparison N = 24	84.7%	11.0%	0.7%	3.6%
First Grade	Experimental N = 25	88.2%	9.9%	0.2%	1.7%
	Comparison N = 23	90.6%	9.1%	0.0%	0.3%

As can be seen in the above table, there is little difference in the percent of Qualified Correct responses given. The differences between experimental and comparison classes on "Correct Responses" was discussed in reference to Table 6. There is, however, a trend worth noting in the columns headed "No Response" and "Incorrect Response". It appears that more of the disadvantaged kindergarten children say they do not know or give no response; whereas more of the higher socio-economic kindergarten class hazard an answer and take the chance of being wrong, and more of them do give incorrect responses. At first grade, all of the higher socio-economic children gave some response, and very few of them incorrect ones. Very few children in the disadvantaged first grade gave no response.

To take this analysis of responses to the Object Recognition assessment one step further, Table 8 presents the frequency of each kind of response coded "Qualified Correct" for the same four classrooms whose responses were given in Table 7.

TABLE 8

OBJECT RECOGNITION: Initial Inventory
CODING OF QUALIFIED CORRECT RESPONSES FOR FOUR CLASSROOMS

		Class Name, Not Object Name	Function, Not Name	Describes Details, No Name	Names Object within Same Class	Incorrect Name, Changes to Correct
Kinder-garten	Experimental N = 25	3	7	0	39	9
	Comparison N = 24	0	12	0	23	23
First Grade	Experimental N = 25	0	15	0	31	11
	Comparison N = 23	2	8	0	19	21

Differences between the classes are clear in the last two columns of Table 8, with more of the experimental than comparison children giving responses coded "Names Object within Same Class", and more of the comparison kindergarten and first grade children giving responses coded as "Incorrect Name, Changes to Correct".

An example of the column labeled "Names Object within Same Class" is the reply of "rope" when the child is shown a ball of string. The pattern of these classes suggests that these disadvantaged children have classificatory principles, but perhaps they do not have experience with a variety of objects within the class; therefore, they respond with the name of a similar object within the same class which is familiar to them. Another possible explanation is that they have not been made aware of more detailed discriminating attributes, for example, the differences between rope and string in texture or thickness.

The last column, labeled "Incorrect Name, Changes to Correct," shows that there is a much greater frequency of this change in the comparison classes than in the experimental classes. A possible explanation for these findings is that a given stimulus brings forth a series of associations for the more advantaged children. When shown a toy dog, for example, they may think of wolf and fox, as well as dog, because they have seen them at a zoo or seen pictures of them in books. After trying out one response and being asked what else the stimulus object could be, they then have other responses to offer. In the selection of objects for the testing, care was taken to ensure that confusion in labels would not be induced by the appearance of the model used in the testing situation.

The procedure for administering the Photograph and Drawing portions of the recognition assessment was the same as that used for the Object Recognition, the only difference being that the stimulus object was a photograph or a card with a line drawing on it instead of the concrete object.

As stated at the beginning of this section, it was expected that the disadvantaged pupils would have greater difficulty in recognizing representations of objects than they would have in recognizing the concrete objects. The results, as presented in Tables 9 through 12, do not, however, support this prediction. Except for class "a" in the kindergarten (Table 11) and class "B" in first grade, (Tables 10 and 12) the range is restricted, with most of the children being able to respond correctly to all or most of the items, and it is only one child in class "B" who had all responses incorrect. The next lower limits in class "B" are seven for Photograph and six for Drawing Recognition as reflected in the means which are only slightly lower than the other classes. There is only one child in kindergarten "a" who gave no correct responses to the Drawing Recognition (Table 11); the next lowest number of correct responses is five for each of two children in this class.

TABLE 9

PHOTOGRAPH RECOGNITION: Initial Inventory

Kindergarten	Experimental Classes							Comparison Classes		
								Socio-Economic		Curriculum
	a	b	c	d	e	f	g	a'	f'	g'
N of Pupils	17	15	44	27	28	25	27	28	23	27
Range: Correct Responses	0-10	8-10	7-10	8-10	8-10	8-10	7-10	8-10	7-10	8-10
Mean	8.84	9.53	9.14	9.44	9.75	9.44	8.78	9.29	9.39	9.56
S. D.	0.59	0.62	0.76	0.57	0.57	0.57	0.96	0.59	0.92	0.57

Possible Correct = 10

TABLE 10

PHOTOGRAPH RECOGNITION: Initial Inventory

First Grade	Experimental Classes								Comparison Classes		
									Socio-Economic		Curriculum
	A	B	C	D	E	F	G	H	A'	G'	H'
N of Pupils	35	34	25	24	25	28	25	19	31	24	24
Range: Correct Responses	8-10	0-10	7-10	9-10	8-10	8-10	9-10	9-10	8-10	8-10	9-10
Mean	9.20	8.94	9.40	9.88	9.68	9.61	9.44	9.68	9.48	9.50	9.67
S. D.	0.67	1.66	0.75	0.33	0.55	0.56	0.50	0.46	0.67	0.58	0.47

Possible Correct = 10

It was expected that the pupils would perform better on the Photograph Recognition than on the Drawing Recognition assessment because of the additional visual cues provided in a photograph which are lacking in a line drawing. This prediction does not appear to be supported if a comparison is made of the class means shown in Table 11 and 12, following, with those in Tables 9 and 10 above. It should be noted in reading the means that there were ten items in the Photograph Recognition and only seven items in the Drawing Recognition.

TABLE 11

DRAWING RECOGNITION: Initial Inventory

Kindergarten	Experimental Classes							Comparison Classes		
								Socio-Economic		Curriculum
	a	b	c	d	e	f	g	a'	f'	g'
N of Pupils	19	15	44	27	28	25	27	28	23	27
Range: Correct Responses	0-7	6-7	4-7	5-7	6-7	6-7	5-7	5-7	5-7	6-7
Mean	5.79	6.60	6.25	6.59	6.86	6.60	6.41	6.32	6.70	6.63
S. D.	1.47	0.49	0.64	0.56	0.35	0.49	0.56	0.60	0.55	0.48

Possible Correct = 7

TABLE 12

DRAWING RECOGNITION: Initial Inventory

First Grade	Experimental Classes								Comparison Classes		
									Socio-Economic		Curriculum
	A	B	C	D	E	F	G	H	A'	G'	H'
N of Pupils	35	33	25	24	25	28	25	19	31	24	24
Range: Correct Responses	6-7	0-7	5-7	6-7	5-7	6-7	6-7	6-7	5-7	6-7	6-7
Mean	6.40	6.26	6.48	6.92	6.56	6.71	6.56	6.84	6.77	6.71	6.63
S. D.	0.49	1.20	0.57	0.28	0.57	0.45	0.50	0.36	0.49	0.45	0.48

Possible Correct = 7

Although there is slightly more variability within the experimental classes, the differences between means are small and are not statistically significant as can be seen in the following tables, Tables 13 and 14.

TABLE 13

DIFFERENCES BETWEEN SAMPLE MEANS ON PHOTOGRAPH RECOGNITION: Initial Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	9.265		9.560	185, 27	-2.062	n.s.(.05)
	9.265	9.335		185, 51	-0.617	n.s.
		9.335	9.560	51, 27	-1.359	n.s.
First Grade	9.438		9.670	215, 24	-1.242	n.s.
	9.438	9.489		215, 55	-0.395	n.s.
		9.489	9.670	55, 24	-1.234	n.s.

TABLE 14

DIFFERENCES BETWEEN SAMPLE MEANS ON DRAWING RECOGNITION: Initial Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	6.444		6.630	185, 27	-1.408	n.s.
	6.444	6.491		185, 51	-0.461	n.s.
		6.491	6.630	51, 27	-1.053	n.s.
First Grade	6.562		6.630	215, 24	-0.474	n.s.
	6.562	6.744		215, 55	-1.862	n.s.
		6.744	6.630	55, 24	-0.965	n.s.

What these results on Photograph and, especially, Drawing Recognition suggest is that children from disadvantaged backgrounds should be able to handle, at least on the dimension of recognition, representation of objects as presented in such workbook materials as SMSG offers. These results further suggest that the experimental children are not starting at a serious disadvantage on recognition.

2. Visual Memory

In the development of cognitive processes, the progression appears to be from reliance on perceptual cues in the early childhood years to greater conceptualization by adolescence. The process by which this development is thought to occur is through some central mediating responses. That is, the child begins to form mental representations of objects -- symbols which stand for concrete objects or events, and he is gradually able to manipulate these in thought. Mathematics learning relies on conceptual thought, although the teaching of SMSG in the early school years uses perceptual cues as the basis from which to abstract.

Visual memory is considered one of the possible mediating responses between perception of concrete objects and thinking more abstractly. To measure visual memory in this study, a set of familiar objects (e.g., toy car, pencil, clock) was placed in a row in front of the child.[7] The child was instructed to look carefully at each of them. After a short period, the child was told, "I am going to take one of these away (experimenter pointed to each object separately) while you have your eyes closed." A specified object was removed, and the pupil was asked to open his eyes and tell the experimenter what had been removed. The child was asked three specified questions to obtain a measure of recall of the object. If he could not remember the object removed, he was shown a new set of objects, one of whose members was the removed object. This allowed for a measure of recognition of the object when the child saw it in a new context.

Table 15 shows the means and standard deviations of the first recall responses for the kindergarten classes on the Visual Memory assessment, and Table 16 presents the same statistics for the first grade classes.

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[7] See Appendix C, page 105, for instructions and a list of the objects used.

TABLE 15

VISUAL MEMORY-OBJECTS: Initial Inventory
First Recall Responses

Kindergarten	Experimental Classes							Comparison Classes		
								Socio-Economic		Curriculum
	a	b	c	d	e	f	g	a'	f'	g'
N of Pupils	19	15	44	27	28	25	27	28	23	27
Range: Correct Responses	0-5	1-4	0-5	0-5	0-5	0-3	0-4	0-4	0-5	1-5
Mean	2.42	2.80	2.95	2.85	2.75	2.28	2.19	2.21	2.61	3.78
S. D.	1.73	1.05	1.09	1.21	1.33	0.78	1.31	1.11	1.52	0.96

Possible Correct = 5

TABLE 16

VISUAL MEMORY-OBJECTS: Initial Inventory
First Recall Responses

First Grade	Experimental Classes								Comparison Classes		
									Socio-Economic		Curriculum
	A	B	C	D	E	F	G	H	A'	G'	H'
N of Pupils	35	34	25	24	25	28	25	19	31	24	24
Range: Correct Responses	0-5	0-5	0-5	1-4	1-5	1-5	0-5	2-5	1-4	1-5	1-5
Mean	2.97	3.12	3.16	2.54	3.72	3.25	3.04	3.74	2.68	2.92	3.79
S. D.	1.48	1.53	1.16	1.08	1.08	0.87	1.25	0.96	0.89	1.04	1.15

Possible Correct = 5

It can be seen from Tables 15 and 16 and from Table 17, which follows, that, on the basis of first recall responses, the experimental classes perform better than do the socio-economic comparison classes. This difference is directional for both the kindergartens and first grades although the difference reaches the .05 level in the first grades (Table 17).

The significantly higher performance of the curriculum comparison kindergarten and, to a lesser extent of the first grade, over both the experimental and the socio-economic comparison samples is difficult to explain without more information on the earlier experiences of these children.

TABLE 17

DIFFERENCES BETWEEN SAMPLE MEANS
ON VISUAL MEMORY-OBJECTS: Initial Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	2.637		3.780	185, 27	-4.725	.001
	2.637	2.390		185, 51	1.278	n.s.
		2.390	3.780	51, 27	-4.857	.001
First Grade	3.168		3.790	215, 24	-2.299	n.s.(.05)
	3.168	2.785		215, 55	2.094	n.s.(.05)
		2.785	3.790	55, 24	-3.999	.001

Future analysis of the second and third recall responses and of the recognition responses, as well as the relationship of Visual Memory performance to other performance measures may yield more meaning about the importance of this mediating response to learning. It can be stated, on the basis of this first-order analysis, however, that the experimental children do not show a disadvantage when compared to the higher socio-economic classes on this measure of visual memory.

3. Color Inventory

As stated in the introduction to the Initial Inventory, color is an important classificatory principle in the early school years. It was recognized, however, that different abilities are involved in matching colors from those required for naming colors. Being able to match two objects of the same hue is a task dependent upon perceptual development, whereas giving the color name to an object is more dependent upon the child's experience in having a particular word (e.g., red) consistently attached to a particular hue. Identifying an object, when given its color name, demands yet another level of development. Thus, the Color Inventory included three separate tasks: matching, naming, and identifying.

The materials used for the three sections of the Color Inventory[8] were cards ($3\frac{1}{2}" \times 3\frac{1}{2}"$ in size) with a circular region of color ($2\frac{1}{2}"$ in diameter) in the center of the card. The ability to match colors was measured by having a set of color cards (yellow, blue, brown, green, orange, and red) arranged in a specified order in front of the experimenter and an equivalent set, but with a black card added, arranged in a different, but also specified order in front of the pupil. The experimenter touched a card, without naming it, and said, "Look at the color card I am touching. Now look at all of your color cards. Do you have one just like it?" This was repeated for each color in the experimenter's set. If the child did not spontaneously touch his matching color card after these initial directions, he was instructed to put his finger on the color card in his set which was the same as the one the experimenter was touching.

When matching was completed, the experimenter removed her set of cards. To test color naming, she said, "Can you tell me the names of the colors? What color is this?", pointing to one of the pupil's color cards.

Identifying colors was tested by asking the child, "Would you give me the red card?" This procedure was used for all colors except black.

Table 18 shows the results for the kindergarten classes on all three parts of the Color Inventory. On the matching of colors, there is little difference between the experimental and the socio-economic comparison classes on either means or standard deviations. It might be noted, however, that there are no comparison classes in which children matched fewer than two colors while there are three experimental classes (b, c, g) in which at least one child could match none of the colors or only one of them. On the other hand, there is one experimental class (e) in which all of the children matched all six colors, and in one curriculum comparison class (g'), almost all of the children matched all six colors correctly. These findings suggest a greater heterogeneity within the experimental classes as well as between them.

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[8] For instructions, see Appendix C, page 108.

TABLE 18

COLOR INVENTORY: Initial Inventory

		Kindergarten							Comparison Classes		
									Socio-Economic		Curriculum
		a	b	c	d	e	f	g	a'	f'	g'
	N	19	15	44	24	28	25	27	28	23	27
MATCHING Possible Correct=6	Range	4-6	1-6	1-6	3-6	all6	2-6	0-6	4-6	2-6	5-6
	Mean	5.79	5.53	5.02	5.52	6.00	5.40	5.19	5.61	5.43	5.96
	S.D.	0.52	1.31	1.22	0.74	0.00	1.02	1.33	0.67	1.01	0.19
NAMING Possible Correct=7	Range	0-7	0-7	0-7	1-7	1-7	2-7	0-7	4-7	1-7	1-7
	Mean	4.47	4.73	5.09	5.41	4.79	5.36	3.93	6.64	5.74	5.04
	S.D.	2.52	2.89	2.04	2.04	2.02	1.79	2.94	0.67	1.98	1.84
IDENTIFYING Possible Correct=6	Range	0-6	0-6	0-6	2-6	0-6	2-6	0-6	3-6	0-6	0-6
	Mean	3.74	4.53	3.84	4.85	4.18	4.80	3.33	5.61	4.61	4.19
	S.D.	2.59	2.33	2.13	1.56	1.85	1.60	2.60	0.77	2.08	1.96

In the Naming section, as in Matching, more variability can be observed within the experimental classes. In addition, the means of the disadvantaged, experimental pupils on this measure are noticeably lower than are the means of the higher socio-economic comparison classes. This suggests that, although there is little difference between the disadvantaged and more advantaged groups on the perceptual skills involved in matching colors, the knowledge of color names, more dependent upon the experiences in pre-school years, is not as well established for many of the disadvantaged children.

The identification of an object by being told only its color is no more difficult than is the task of naming the colors, as can be observed by comparing the means on the Naming and Identifying sections in Table 18. It should be noted, in comparing the means on Naming and Identifying, that there were seven possible correct responses in the Naming section and six possible correct in the Identifying section.

TABLE 19

DIFFERENCES BETWEEN SAMPLE MEANS
ON COLOR INVENTORY: Initial Inventory

Kindergarten	Sample Means			N	t	Significance
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
MATCHING	5.438		5.960	185, 27	-2.617	.01
	5.438	5.529		185, 51	-0.580	n.s.
		5.529	5.960	51,185	-2.646	.01
NAMING	4.866		5.040	185, 27	-0.385	n.s.
	4.866	6.234		185, 51	-4.157	.001
		6.234	5.040	51, 27	3.210	.01
IDENTIFYING	4.140		4.190	185, 27	-0.117	n.s.
	4.140	5.159		185, 51	-3.266	.01
		5.159	4.190	51, 27	2.445	n.s.(.02)

Table 19, above, presents the sample means on the three parts of the Color Inventory for the kindergarten groups. These results confirm, statistically, the trends seen in the means by class shown in Table 18. It is interesting to note that the curriculum comparison kindergarten performs (<.01) significantly better than either the experimental or the socio-economic comparison groups on Matching but is significantly poorer (.01) in performance than the higher socio-economic group on Naming and nearly significantly poorer (.02) on Identifying.

The following two tables, Tables 20 and 21, present results for the first grade classes comparable to those presented for the kindergarten on the Color Inventory.

TABLE 20

COLOR INVENTORY: Initial Inventory

First Grade		Experimental								Comparison Classes		
										Socio-Economic		Curriculum
		A	B	C	D	E	F	G	H	A'	G'	H'
	N	35	34	25	24	25	28	25	19	31	24	24
MATCHING	Range	0-6	0-6	4-6	4-6	all6	5-6	4-6	4-6	5-6	all6	all6
Possible Correct=6	Mean	4.91	5.56	5.80	5.79	6.00	5.96	5.52	5.79	5.97	6.00	6.00
	S.D.	1.54	1.12	0.49	0.50	0.00	0.19	0.85	0.52	0.18	0.00	0.00
NAMING	Range	0-7	1-7	0-7	0-7	4-7	0-7	0-7	5-7	4-7	5-7	6-7
Possible Correct=7	Mean	5.66	6.68	6.16	5.63	6.56	5.82	6.00	6.53	6.90	6 92	6.96
	S.D.	2.60	1.13	1.64	1.87	0.80	2.49	1.47	0.82	0.53	0.40	0.20
IDENTIFYING	Range	0-6	0-6	1-6	0-6	0-6	0-6	1-6	4-6	5-6	all6	all6
Possible Correct=6	Mean	4.91	5.65	5.04	4.79	5.64	5.50	5.04	5.58	5.97	6.00	6.00
	S.D.	2.26	1.16	1.56	2.02	1.23	1.50	1.43	0.82	0.18	0.00	0.00

TABLE 21

DIFFERENCES BETWEEN SAMPLE MEANS ON COLOR INVENTORY: Initial Inventory

First Grade	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
MATCHING	5.627		6.000	215, 24	-1.946	n.s.
	5.627	5.983		215, 55	-2.805	.01
		5.983	6.000	55, 24	-0.579	n.s.
NAMING	6.118		6.960	215, 24	-2.227	n.s.(.05)
	6.118	6.909		215, 55	-3.143	.01
		6.909	6.960	55, 24	-0.491	n.s.
IDENTIFYING	5.265		6.000	215, 24	-2.197	n.s.(.05)
	5.265	5.983		215, 55	-3.248	.01
		5.983	6.000	55, 24	-0.579	n.s.

As can be seen from Table 20, there are children even in the first grade disadvantaged classes (A and B) who can match none of the six colors. Thus, although the difference between the experimental and more advantaged group on Matching was not significant at kindergarten (Table 19), this difference is significant at first grade (Table 21). The differences on Naming and Identifying are significant for the first grades as they were for the kindergartens. In fact, the differences would likely be greater if this assessment had been longer or more difficult as can be seen by the comparison classes in which all of the children were able to do all of the tasks correctly.

4. Number Concepts

Several facets of number ideas and skills were assessed in the Initial Inventory. These included counting of objects, rote counting, recognition of numerals, and writing numerals.[9] These will be presented individually.

a. Counting Objects

To measure the children's ability to count objects, a pile of buttons was placed in front of the child. He was asked to place three buttons in a box; then five, four, six, eight, seven, and nine buttons.

TABLE 22

COUNTING BUTTONS: Initial Inventory

Kindergarten	Experimental Classes							Comparison Classes		
								Socio-Economic		Curriculum
	a	b	c	d	e	f	g	a'	f'	g'
N of Pupils	19	15	44	27	28	25	27	28	23	27
Range: Correct Responses	0-7	0-7	0-7	0-7	0-7	0-6	0-7	0-7	0-7	0-7
Mean	2.68	2.20	3.45	3.52	3.00	2.24	2.56	5.14	3.87	4.44
S. D.	2.39	2.40	2.51	2.60	2.48	1.66	2.60	2.18	2.47	2.42

Possible Correct = 7

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[9] See Appendix C, pages 116-122, for instructions on the number concept assessments.

TABLE 23

COUNTING BUTTONS: Initial Inventory

First Grade	Experimental Classes								Comparison Classes		
									Socio-Economic		Curriculum
	A	B	C	D	E	F	G	H	A'	G'	H'
N of Pupils	35	34	25	24	25	28	25	19	31	24	24
Range: Correct Responses	0-7	0-7	0-7	0-7	0-7	0-7	0-7	1-7	6-7	4-7	5-7
Mean	4.94	4.74	5.52	3.88	5.56	4.75	5.76	5.05	6.74	6.50	6.79
S. D.	2.54	2.65	1.90	2.11	2.21	2.37	1.99	1.99	0.44	1.00	0.50

Possible Correct = 7

The results on the object counting task are presented in Table 22 for the kindergarten classes and in Table 23 for the first grades. The range of means of the experimental kindergarten classes is 2.20 to 3.52, while the means of the two higher socio-economic classes are 3.87 and 5.14. These findings reflect more clearly than do the findings on the assessments previously discussed the difference in experiences prior to kindergarten between the disadvantaged and more advantaged children.

Although the first grade experimental classes are able to do, correctly, two more counting tasks than are the kindergarten children (first grade means ranging from 3.88 to 5.76), the disadvantaged children at the beginning of first grade are still not performing as well as the higher socio-economic classes (6.50 and 6.74). In addition, the variability within the experimental first grades, as evidenced by the magnitude of the sigmas given in Table 23, is much greater than for the comparison classes.

TABLE 24

DIFFERENCES BETWEEN SAMPLE MEANS
ON COUNTING BUTTONS: Initial Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	2.918		4.440	185, 27	-3.022	.01
	2.918	4.567		185, 51	-4.314	.001
		4.567	4.440	51, 27	0.225	n.s.
First Grade	5.010		6.790	215, 24	-3.732	.001
	5.010	6.635		215, 55	-5.113	.001
		6.635	6.790	55, 24	-0.964	n.s.

Table 24 shows the results of the tests of significance between the sample means for both the kindergarten and first grade groups on Counting Buttons. It indicates clearly the differences between the disadvantaged and the higher socio-economic comparison groups. The differences between means for both the kindergarten and first grades are significant at the .001 level of significance. It further indicates that the curriculum comparison group is more similar to the more advantaged group than it is to the experimental group, a finding which has been evident, but not as clear as on this counting assessment, on certain of the other assessment results.

b. Rote Counting

Rote counting was tested in order to learn whether the children had number names and whether they had any concept of counting. It was not expected that there would be a positive correlation between rote counting and understanding of number concepts.

To test rote counting each child was asked, "Will you count for me?" If he did not respond, the experimenter said she would start and that the child should go on.

TABLE 25

ROTE COUNTING: Initial Inventory

Kindergarten	Experimental Classes							Comparison Classes		
								Socio-Economic		Curriculum
	a	b	c	d	e	f	g	a'	f'	g'
N of Pupils	19	15	43	27	28	25	27	28	23	27
Range: Correct Responses	0-3	0-2	0-4	0-8	0-8	1-5	0-8	0-8	0-8	1-8
Mean	0.95	0.67	1.26	2.00	2.81	2.72	2.30	2.07	2.39	2.00
S. D.	0.94	0.39	1.41	2.51	1.82	1.37	2.05	1.93	1.81	2.02

Possible Correct = 8

First Grade	Experimental Classes								Comparison Classes		
									Socio-Economic		Curriculum
	A	B	C	D	E	F	G	H	A'	G'	H'
N of Pupils	32	33	39	30	25	27	25	19	31	24	28
Range: Correct Responses	0-8	0-8	0-8	0-4	0-8	0-8	0-5	1-7	1-8	1-8	1-8
Mean	3.13	2.06	2.74	1.23	2.33	2.44	2.08	2.32	5.00	4.92	4.50
S. D.	2.58	1.82	2.01	1.05	1.47	2.83	1.47	1.45	2.77	2.69	2.51

Possible Correct = 8

In reading Table 25, it is necessary to understand the scoring of the children's responses to the rote counting task. A zero was scored for counting, without error, from zero to nine. If the child counted correctly between ten and nineteen, he was given a score of one. A two was scored for counting correctly anywhere between twenty and twenty-nine. This system was maintained for scoring through seventy-nine. A score of eight was given for counting correctly from eighty through one hundred.

An examination of the means in Table 25 shows that the kindergarten experimental classes vary widely in their performance on this task. It further shows that there are experimental classes whose performance is very similar to that of the comparison classes. By contrast to results presented previously, the variability, as the sigmas show, is not greater for most of the experimental classes. The range of scores for classes a, b, and c, however, is restricted to the lower end of the scoring categories. No child in these classes could count to more than fifty, while in three of the other four experimental classes (d,e,g) and in all of the comparison classes some of the children were able to count to eighty without error.

By contrast, the first grade experimental classes do not perform as well as the comparison classes, as shown by the means in Table 25. There are children in all but one of the first grade experimental classes who can not count beyond nine without error. The pattern of variability noted for the kindergartens on Rote Counting is similar in the first grades, however, with the comparison classes showing at least as large sigmas as the experimental classes.

TABLE 26

DIFFERENCES BETWEEN SAMPLE MEANS ON ROTE COUNTING: Initial Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Economic Comp.	Curric. Comp.			
Kindergarten	1.360		2.000	184, 27	-1.734	n.s.
	1.360	1.670		184, 51	-1.094	n.s.
		1.670	2.000	51, 27	0.698	n.s.
First Grade	2.320		4.500	255, 28	-5.232	.001
	2.320	4.930		255, 49	-8.275	.001
		4.930	4.500	59, 28	-0.688	n.s.

Table 26 shows the extent of the differences between the experimental and comparison first grade samples. The disadvantaged first graders perform significantly ($p < .001$) less well on this rote counting task than either comparison group although the disadvantaged kindergarten children perform statistically no differently from their comparison groups. These findings suggest the frequently noted observation of increasing discrepancy in performance between disadvantaged and more advantaged children as they progress from grade to grade.

c. Recognition of Number Symbols

To test whether a child could associate a written number with its spoken name, the child was shown a sealed envelope containing a specified number of counting discs with the appropriate numeral written on the front of the envelope. A practice task was included in order to instruct the child on the nature of the task. He was told that the envelope the experimenter showed him had some buttons in it and that the "2" on the envelope told how many buttons were inside. Five other envelopes were then spread out on the table, and the child was asked to give the experimenter the envelope that had three buttons inside, then one, and four. If the child was not successful with these, this assessment was stopped. If he was able to find the above numerals, the assessment was continued with numerals through nine.

Table 27 presents the class means for the kindergartens on the Recognition of Number Symbols, and Table 28 presents the results for the first grade classes.

TABLE 27

NUMBER SYMBOLS-RECOGNITION: Initial Inventory

Kindergarten	Experimental Classes							Comparison Classes		
								Socio-Economic		Curriculum
	a	b	c	d	e	f	g	a'	f'	g'
N of Pupils	19	15	44	27	38	25	27	28	23	27
Range: Correct Responses	0-8	0-6	0-8	0-8	0-8	0-8	0-8	0-8	0-8	0-8
Mean	1.47	0.93	3.16	4.93	2.36	2.76	3.56	5.50	5.09	3.30
S. D.	2.84	1.57	2.61	2.90	2.41	2.29	2.60	2.49	2.75	2.66

Possible Correct = 8

Although there are some children in all of the kindergarten classes, both experimental and comparison, who can not recognize any of the numerals presented, the class means are again lower for the experimental than for the two higher socio-economic classes, with the disadvantaged children recognizing on the average, two to three numerals, and the more advantaged children recognizing five. Although the variability within the experimental classes is no greater than it is in the comparison classes at the beginning of kindergarten, as indicated by the size of the standard deviations in Table 27, the variability is quite different at the beginning of first grade as can be seen in

Table 28 below. In the first grade socio-economic comparison classes (A' and G'), all or most of the children are able to recognize all eight numerals presented as shown by the means and sigmas of these two classes. On the other hand, the experimental class means range between 4.47 and 6.89 with much larger sigmas.

TABLE 28

NUMBER SYMBOLS-RECOGNITION: Initial Inventory

First Grade	Experimental Classes								Comparison Classes		
									Socio-Economic		Curriculum
	A	B	C	D	E	F	G	H	A'	G'	H'
N of Pupils	35	34	25	24	25	28	25	19	31	24	24
Range: Correct Responses	0-8	0-8	1-8	1-8	0-8	0-8	0-8	3-8	all8	5-8	5-8
Mean	4.51	4.47	6.44	5.67	5.96	5.46	6.04	6.89	8.00	7.88	7.63
S. D.	3.23	3.12	2.21	2.11	2.51	2.56	2.79	1.77	0.00	0.60	0.81

Possible Correct = 8

When the above data are grouped and examined as sample means, the differences between the experimental and the comparison samples are clearly significant. Table 29 presents these means as well as the t test values.

TABLE 29

DIFFERENCES BETWEEN SAMPLE MEANS ON RECOGNITION OF NUMBER SYMBOLS: Initial Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	2.947		3.300	185, 27	-0.661	n.s.
	2.947	5.315		185, 51	-5.791	.001
		5.315	3.300	51, 27	-3.190	.01
First Grade	5.538		7.630	215, 24	-3.713	.001
	5.538	7.948		215, 55	-6.496	.001
		7.948	7.630	55, 24	-2.370	n.s.(.02)

It can readily be seen that the experimental, disadvantaged kindergarten group is not significantly different from the curriculum comparison group in performance on Recognition of Number Symbols, but the experimental first grade group performs significantly less well. On the other hand, the experimental children, at both kindergarten and first grade, perform significantly less well than the socio-economic comparison pupils. These findings suggest the continuing, and probably increasing, lag in performance of children from disadvantaged areas by comparison to the initial and continuing higher performance of more advantaged children. Interpretation of the findings on the curriculum comparison groups is more difficult without more information about the population from which they are drawn.

d. Marking Number Symbols

Included with the counting assessment (Counting Buttons) was the request that the child write the numeral on a paper to tell how many buttons he had counted and placed in a box. As could be expected, this was not a task which many children beginning kindergarten could accomplish. Table 30 presents the results for the kindergarten classes, and Table 31 presents the results of the first graders' performance.

TABLE 30

NUMBER SYMBOLS-MARKING: Initial Inventory

Kindergarten	Experimental Classes							Comparison Classes		
								Socio-Economic		Curriculum
	a	b	c	d	e	f	g	a'	f'	g'
N of Pupils	19	15	44	27	28	25	27	28	23	27
Range: Correct Responses	0-5	0-3	0-7	0-6	0-6	0-2	0-2	0-7	0-7	0-7
Mean	0.47	0.47	0.84	1.33	0.75	0.36	0.81	1.18	1.17	0.74
S. D.	1.19	0.88	1.49	1.83	1.55	0.62	1.61	1.75	1.95	1.73

Possible Correct = 7

TABLE 31

NUMBER SYMBOLS-MARKING: Initial Inventory

First Grade	Experimental Classes								Comparison Classes		
									Socio-Economic		Curriculum
	A	B	C	D	E	F	G	H	A'	G'	H'
N of Pupils	35	34	25	24	25	28	25	19	31	24	24
Range: Correct Responses	0-7	0-7	0-7	0-5	0-6	0-7	0-7	0-7	2-7	3-7	3-7
Mean	2.00	2.74	3.96	2.17	1.84	3.04	2.04	2.79	5.58	6.08	5.50
S. D.	2.26	2.92	2.09	1.55	1.91	2.65	1.99	2.17	1.43	1.35	1.19

Possible Correct = 7

There is a very slight difference in the kindergarten children's performance on the marking number symbol task favoring the socio-economic comparison classes, with the mean of only one experimental class (d) being over one. The first grade experimental classes, however, are considerably more discrepant from their comparison classes with means of two and three out of a possible seven compared to five and six in the comparison classes (A' and G').

Table 32 shows that these differences are not significant at the beginning of kindergarten, but at the beginning of the first grade, the performance of both comparison samples is significantly better than that of the experimental sample.

TABLE 32

DIFFERENCES BETWEEN SAMPLE MEANS ON MARKING NUMBER SYMBOLS: Initial Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	0.761		0.740	185, 27	0.068	n.s.
	0.761	1.175		185, 51	-1.686	n.s.
		1.175	0.740	51, 27	1.003	n.s.
First Grade	2.555		5.500	215, 24	-6.101	.001
	2.555	5.789		215, 55	-9.846	.001
		5.789	5.500	55, 24	0.870	n.s.

VII RESULTS AND DISCUSSION: MIDYEAR INVENTORY

The aim of the January testing, henceforth referred to as the Midyear Inventory, was to assess the pupils' progress in set and number ideas, vocabulary related to mathematics understanding, and principles of ordering and classification.

1. Vocabulary

Since one major objective of mathematics instruction in the elementary grades is growth in children's ability to use the language of mathematics effectively, an assessment of vocabulary basic to such language was made. Certain mathematical concepts do not require technical vocabulary but do rely on understanding and facility in using more general language.

The vocabulary assessment contained fifteen items and was administered by having the child manipulate wooden blocks in specified ways to indicate his understanding of such words and expressions as "on", "as many as", "outside".[10]

A basic assumption underlying studies such as the one here reported is that disadvantaged children, if given the materials and conditions advantageous to learning, can compensate for at least some of their earlier deprivation. Therefore, our prediction would be that these children, provided with special mathematics materials, should perform better by the middle of the school year on tests of mathematics-relevant material than they did at the beginning of the school year, by comparison with more advantaged children.

TABLE 33

VOCABULARY: Midyear Inventory

Kindergarten	Experimental Classes						Comparison Classes	
							Socio-Economic	Curriculum
	a	c	d	e	f	g	f'	g'
N of Pupils	19	44	27	28	25	27	23	27
Range: Correct Responses	3-11	7-15	9-15	9-15	10-15	10-15	4-15	10-15
Mean	8.21	12.41	13.07	13.57	13.60	13.26	12.83	12.44
S. D.	2.53	1.67	1.54	1.76	1.47	1.14	2.43	1.10

Possible Correct = 15

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[10] See Appendix C , page 100, for instructions and a description of the materials used.

As can be seen from Table 33, four of the six[11] experimental kindergarten classes tested have higher means on the Vocabulary assessment than the socio-economic comparison and the curriculum comparison classes. The mean of 12.41 for class c is very close to that of the comparison classes. It is only class a whose performance is clearly poorer.

TABLE 34

VOCABULARY: Midyear Inventory

First Grade	Experimental Classes								Comparison Classes	
									Socio-Economic	Curriculum
	A	B	C	D	E	F	G	H	G'	H'
N of Pupils	32	35	25	24	25	28	25	19	24	24
Range: Correct Responses	7-15	5-15	8-15	9-15	13-15	8-15	11-15	11-15	12-15	7-15
Mean	12.59	12.20	12.96	13.50	14.52	12.79	13.40	13.58	14.38	13.00
S. D.	2.18	2.20	1.71	1.63	0.75	1.59	1.17	1.14	0.95	2.00

Possible Correct = 15

The findings for the first grades on the Vocabulary assessment look quite different as can be seen in Table 34. Only one experimental class (E) performed better than the higher socio-economic comparison class. Four of the experimental classes had higher means than the curriculum comparison class which suggests that these disadvantaged children are learning language from a curriculum that stresses it.

The strength of the differences is less clear-cut when the means of the various treatment groups are compared statistically. Table 35 presents the mean for the entire experimental sample, and gives the value of t for the difference between means of the experimental and the two comparison samples, by grade level.

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[11] It was not possible to test experimental class b or comparison class a'.

TABLE 35

DIFFERENCES BETWEEN SAMPLE MEANS
ON VOCABULARY ASSESSMENT: Midyear Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	12.546		12.440	170, 27	0.320	n.s.
	12.546	12.830		170, 23	-0.720	n.s.
		12.830	12.440	23, 27	0.734	n.s.
First Grade	13.108		13.000	213, 24	0.282	n.s.
	13.108	14.380		213, 24	-3.496	.001
		14.380	13.000	24, 24	2.989	.01

As can be observed in this table, there are no significant differences in performance at the kindergarten level between any two of the groups. At first grade, however, the higher socio-economic group's performance is significantly higher than both the experimental sample and the class being taught a non-SMSG curriculum, although no difference exists between the latter two groups. One possible interpretation of these findings is that starting special programs at kindergarten with disadvantaged children is more effective than starting at first grade if the desired criterion is performance at the same level as more advantaged children. A crucial test of this would be the performance of the present kindergarten classes a year hence when they have been in the SMSG curriculum for two years, as compared with the present first graders who started the program during first grade.

2. Geometric Shapes

Geometry is an area of mathematics introduced in the SMSG curriculum at kindergarten. It is begun by making the children aware of the characteristics of various shapes and familiarizing them with some of the vocabulary associated with geometric shapes.

The Geometric Shapes assessment was constructed in the same format as the Color Inventory administered in the Initial Inventory at the beginning of the school year. The shapes used were circular, square, triangular, and rectangular regions which the child was to match, then name, and lastly, identify.[12]

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[12] See Appendix C , page 111, for instructions and a description of the materials used.

TABLE 36

GEOMETRIC SHAPES: Midyear Inventory

Kindergarten		Experimental Classes					Comparison Classes	
							Socio-Economic	Curriculum
		c	d	e	f	g	f'	g'
	N of Pupils	44	27	28	25	27	23	27
MATCHING	Range	0-4	2-4	0-4	all4	all4	2-4	all4
Possible Correct=4	Mean	3.80	3.89	3.71	4.00	4.00	3.87	4.00
	S. D.	0.84	0.42	1.03	0.00	0.00	0.45	0.00
NAMING	Range	1-4	1-4	0-4	1-4	1-4	0-4	0-3
Possible Correct=4	Mean	2.91	3.56	3.36	3.24	2.93	3.35	0.81
	S. D.	1.04	0.83	1.32	0.95	0.98	1.05	1.02
IDENTIFYING	Range	1-4	1-4	0-4	1-4	1-4	0-4	1-4
Possible Correct=4	Mean	3.48	3.63	3.68	3.20	3.11	3.43	2.63
	S. D.	0.94	0.82	1.04	1.13	0.96	1.14	1.25

TABLE 37

GEOMETRIC SHAPES: Midyear Inventory

First Grade		Experimental Classes								Comparison	
										Socio-Econ.	Curriculum
		A	B	C	D	E	F	G	H	G'	H'
	No of Pupils	32	35	25	24	25	28	25	19	24	24
MATCHING	Range	0-4	0-4	2-4	all4	all4	2-4	0-4	all4	3-4	all4
Possible Correct=4	Mean	3.78	3.06	3.92	4.00	4.00	3.75	3.84	4.00	3.96	4.00
	S. D.	0.74	1.67	0.39	0.00	0.00	0.57	0.78	0.00	0.20	0.00
NAMING	Range	0-4	0-4	0-4	0-4	1-4	0-4	0-3	1-4	2-4	0-4
Possible Correct=4	Mean	1.91	1.37	2.60	3.00	3.60	2.00	1.60	2.37	3.50	1.50
	S. D.	1.07	1.12	1.39	1.22	0.69	1.13	0.89	0.74	0.65	1.29
IDENTI-FYING	Range	1-4	1-4	1-4	1-4	2-4	0-4	1-4	0-4	0-4	1-4
Possible Correct=4	Mean	3.06	2.74	3.28	3.46	3.92	2.79	2.76	3.05	3.63	2.95
	S. D.	0.97	0.91	1.04	1.00	0.39	1.24	0.71	1.10	0.95	0.78

Examination of Tables 36 and 37 shows that almost all of the children, kindergarten as well as first graders, are able to match geometric shapes. It would appear that whatever deprivation these children have experienced, it has not affected the particular perceptual skills involved in the matching of shapes or colors. Differences are seen, however, in both the Naming and Identifying portions of the assessment. It is interesting to note that in the SMSG kindergartens, in both experimental disadvantaged and the higher socio-economic class, the children perform well on Naming and Identifying by

TABLE 38

DIFFERENCES BETWEEN SAMPLE MEANS
ON GEOMETRIC SHAPES: Midyear Inventory

	Sample Means			N	t	Significance Level
Kindergarten	Exper.	Socio-Econ. Comp.	Curric. Comp.			
MATCHING	3.868		4.000	151, 27	-0.980	n.s.
	3.868	3.870		151, 23	-0.013	n.s.
		3.870	4.000	23, 27	-1.471	n.s.
NAMING	3.168		0.810	151, 27	10.795	.001
	3.168	3.350		151, 23	-0.774	n.s.
		3.350	0.810	23, 27	8.483	.001
IDENTIFYING	3.431		2.630	151, 27	3.747	.001
	3.431	3.430		151, 23	0.004	n.s.
		3.430	2.630	23, 27	2.301	n.s.(.05)
First Grade						
MATCHING	3.751		4.000	213, 24	-1.354	n.s.
	3.751	3.960		213, 24	-1.133	n.s.
		3.960	4.000	24, 24	-0.964	n.s.
NAMING	2.240		1.500	213, 24	3.112	.01
	2.240	3.500		213, 24	-5.599	.001
		3.500	1.500	24, 24	6.640	.001
IDENTIFYING	3.108		2.750	213, 24	1.771	n.s.
	3.108	3.630		213, 24	-2.539	n.s.(.02)
		3.630	2.750	24, 24	3.433	.001

comparison to the non-SMSG curriculum class. The first grade classes are much more variable, the individual class's performance probably dependent upon whether a given teacher had yet dealt with the sections of the curriculum on geometry prior to this testing. What is apparent from the first grade results is that, over-all, the disadvantaged children do not perform as well as do the more advantaged children on the latter two parts of this assessment. As Table 38 shows, the kindergarten experimental children look like the more advantaged children using the same curriculum; whereas the first grade disadvantaged pupils perform significantly less well on both the Naming ($t = -5.599$, $p < .001$) and the Identifying ($t = -2.539$, $p < .02$) portions of the Geometric Shapes assessment. The disadvantaged children are clearly learning from the curriculum as can be seen by their significantly higher performance than the non-SMSG group ($t = 3.112$, $p < .01$) on Naming, i.e., being able to name geometric shapes displayed. One interpretation which can be made from these results is that starting a special program at kindergarten, rather than at first grade, is critical in offsetting differences between disadvantaged and more advantaged children.

3. Pairing

The concept of sets may be considered to form a basis for number concepts. As such, it forms one of the foundations of the SMSG elementary curriculum. Some set comparison is introduced in kindergarten through the manipulation of objects. In first grade, pairing of elements of sets is included in the pupil materials. Thus, this Pairing assessment was given only to the first grade pupils within the sample, and was one of the few pencil-and-paper tasks used in the individual testing.

A printed four-page booklet was used. On each page were two sets of pictures of familiar objects or geometric shapes, the two sets separated by a vertical line. The child was asked to pair the members of one set with the members of the other set on the page by drawing a line between members of the two sets.[13]

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[13] See Appendix C, page 113, for instructions.

TABLE 39

PAIRING: Midyear Inventory

First Grade	Experimental Classes								Comparison Classes	
									Socio-Economic	Curriculum
	A	B	C	D	E	F	G	H	G'	H'
N of Pupils	32	35	25	24	25	28	25	19	24	24
Range: Correct Responses	0-4	0-4	0-4	3-4	0-4	0-4	0-4	1-4	3-4	0-4
Mean	3.28	3.11	3.52	3.79	3.44	3.29	2.96	2.26	3.83	1.75
S. D.	1.15	1.35	1.14	0.41	1.30	1.06	1.71	1.48	0.37	1.83

Possible Correct = 4

The means and standard deviations by class, presented in Table 39, again illustrate the variability of performance level within the experimental classes. That these disadvantaged children are learning the material presented, even if not as rapidly as the higher socio-economic group (G'), is indicated by the discrepancy between their class means and that of the non-SMSG class (H').

Table 40 below shows the level of significance of difference between the sample means on the Pairing assessment. It shows, statistically, what was suggested by the previous table, i.e., that the disadvantaged experimental classes perform significantly better than the non-SMSG class on this dimension of set comparison. It further shows that the performance level of the experimental pupils is somewhat lower than that of the higher socio-economic class, but this difference does not achieve the level of significance accepted for this study.

TABLE 40

DIFFERENCES BETWEEN SAMPLE MEANS
ON PAIRING: Midyear Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
First Grade	3.229		1.750	213, 24	5.200	.001
	3.229	3.830		213, 24	-2.345	n.s.(.05)
		3.830	1.750	24, 24	5.345	.001

4. Number Concepts

a. Equivalent Sets

In developing the idea of set comparison, the term equivalence is introduced. The children, through pairing the members of two sets, learn that two sets are equivalent if they have the same number of members.

To test the children's understanding of the concept of equivalence, a series of six cards (6" × 7") was used.[14] Each card had either buttons glued to it or had from four to nine pictures printed on it. Some of these cards had the buttons or pictures placed in definite patterns; others were randomly located on the cards. The child's task was to form a set equivalent to the set presented on the card by placing the correct number of buttons on a sheet of construction paper.

TABLE 41

EQUIVALENT SETS: Midyear Inventory

Kindergarten	Experimental Classes						Comparison Classes	
							Socio-Economic	Curriculum
	a	c	d	e	f	g	f'	g'
N of Pupils	19	44	27	28	25	27	23	27
Range: Correct Responses	0-6	0-6	2-6	0-6	1-6	0-6	0-6	0-6
Mean	2.95	3.64	4.89	4.21	3.72	4.41	4.43	3.56
S. D.	2.01	2.02	1.23	1.88	1.54	1.39	1.93	1.99

Possible Correct = 6

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[14] See Appendix C , page 115 for instructions.

TABLE 42

EQUIVALENT SETS: Midyear Inventory

First Grade	Experimental Classes								Comparison Classes	
									Socio-Economic	Curriculum
	A	B	C	D	E	F	G	H	G'	H'
N of Pupils	32	34	25	24	25	28	25	19	24	24
Range: Correct Responses	1-6	0-6	0-6	2-6	2-6	0-6	3-6	3-6	2-6	0-6
Mean	4.88	4.82	5.36	4.92	5.72	4.75	5.40	5.21	5.67	5.42
S. D.	1.19	1.56	1.29	1.08	0.87	1.81	0.85	0.95	0.85	1.22

Possible Correct = 6

TABLE 43

DIFFERENCES BETWEEN SAMPLE MEANS ON EQUIVALENT SETS: Midyear Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	3.989		3.560	170, 27	1.145	n.s.
	3.989	4.430		170, 23	-1.105	n.s.
		4.430	3.560	23, 27	1.531	n.s.
First Grade	5.104		5.420	212, 24	-1.147	n.s.
	5.104	5.670		212, 24	-2.111	n.s.(.05)
		5.670	5.420	24, 24	1.175	n.s.

The above three tables show the results for the Equivalent Set assessment. On this test, at the middle of the school year, there are no significant differences between the samples. The variability in performance of the experimental classes is not noticeably greater than in the comparison classes, as was noted on many of the assessments in the initial testing.

There were two perceptible strategies by which the children could achieve a correct response on the Equivalent Set assessment. One strategy was copying the pattern on the stimulus card presented; the other strategy was counting the buttons or pictures on the cards, and then counting out an equivalent number of buttons. Since the means of the experimental and curriculum comparison samples are not significantly different (Table 43), it may well be that the two groups employed different strategies to arrive at correct responses. It would be expected that children in the SMSG curriculum would tend to use a copying strategy because of the development of set comparison ideas, while children in a numeration-based curriculum would be more likely to use a counting strategy. A further prediction, which remains to be tested, is that children using set concepts to handle such problems as equivalence have a better understanding of the idea of number and of mathematics.

b. Counting Objects

Counting Buttons is an assessment made at the beginning of the school year and repeated at midyear to ascertain growth in counting. On the Initial Inventory, the scores of both the curriculum comparison and the socio-economic comparison samples were significantly higher (< .001) than the disadvantaged experimental sample. This finding obtained for both the kindergarten and the first grade samples.

The children's performance on this assessment, repeated at midyear, looks quite different as can be seen in the following three tables, particularly Table 46, showing the sample means and t's.

TABLE 44

COUNTING BUTTONS: Midyear Inventory

Kindergarten	Experimental Classes						Comparison Classes	
							Socio-Economic	Curriculum
	a	c	d	e	f	g	f'	g'
N of Pupils	19	44	27	28	25	27	23	27
Range: Correct Responses	0-7	0-7	0-7	0-7	0-7	0-7	0-7	1-7
Mean	2.95	4.55	5.56	4.68	4.72	4.63	5.65	4.96
S. D.	3.24	2.45	1.89	2.62	2.58	2.18	2.35	2.08

Possible Correct = 7

TABLE 45

COUNTING BUTTONS: Midyear Inventory

First Grade	Experimental Classes								Comparison Classes	
									Socio-Economic	Curriculum
	A	B	C	D	E	F	G	H	G'	H'
N of Pupils	32	35	25	24	25	28	25	19	24	24
Range: Correct Responses	3-7	0-7	0-7	2-7	all7	0-7	0-7	6-7	2-7	6-7
Mean	6.75	6.54	6.24	6.04	7.00	6.21	6.24	6.95	6.67	6.92
S. D.	0.83	1.44	1.82	1.37	0.00	1.78	1.77	0.22	1.07	0.28

Possible Correct = 7

TABLE 46

DIFFERENCES BETWEEN SAMPLE MEANS ON COUNTING BUTTONS: Midyear Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	4.591		4.960	170, 27	-0.737	n.s.
	4.591	5.650		170, 23	-1.944	n.s.
		5.650	4.960	23, 27	1.079	n.s.
First Grade	6.492		6.920	213, 24	-1.538	n.s.
	6.492	6.670		213, 24	-0.616	n.s.
		6.670	6.920	24, 24	-1.084	n.s.

The performance of the disadvantaged children on this counting task is no different from the other groups by the middle of the school year, although they had significantly lower scores at the beginning of the school year. The difference in sample means between the Initial and Midyear inventories is 1.673 for the experimental kindergarten sample and 1.482 for the experimental first grade sample. For the socio-economic comparison kindergarten, the difference between the sample means on the Initial and Midyear testing is 1.083, and .035 for the first grades. Comparable differences for the curriculum comparison classes are .529 for the kindergarten and .130 for the first grade. These differences show clearly the progress made by the disadvantaged children in counting, as measured by this test, between the beginning and middle of the school year.

There are two factors to be considered in interpreting these findings. The first concerns the rate of improvement of the disadvantaged pupils; the second concerns the test itself. Since the experimental children were able to improve their performance to the extent shown, there seems little question either about their readiness to learn counting or about their ability to do so. The fact that the gain was greater for the experimental kindergarten sample than for the experimental first grade may be attributed to the kindergarten children starting at a lower level of performance or may indicate the greater potential for change at the earlier age.

The test itself must also be mentioned in interpreting the findings on Counting Buttons. The observation that the socio-economic and curriculum comparison classes showed little improvement in performance between Initial and Midyear inventories can likely be attributed to the low ceiling on the test. That is, with means of 6.635 for the socio-economic comparison first grade and 6.790 for the curriculum comparison on the Initial Inventory out of seven items, it is obvious that these children could not go much higher at midyear. That the kindergarten comparison classes could have had higher means on the Midyear Inventory, in terms of the possibility of seven correct (see Table 44), strengthens the argument about the impressive change in performance of the experimental pupils.

c. Counting Members of a Set

The task of counting members of a given set presented to a child should be less difficult than that of counting out a set of objects from a larger given set. Specifically, it was expected that a child could more easily count the drawings on a card containing a certain number of such drawings than he could sort and count a requested number of buttons from a larger set of buttons. The latter task requires that the child remember how many objects he has been requested to count, while actually going through the operation.

Out of the eight cards presented for the Counting Members of a Set assessment, it can be seen from Table 47 that the class means for the kindergartens are between five and six, except for class a whose mean is 4.21. The class means for the first grades, as presented in Table 48, range between 6.26 and 8.00.

TABLE 47

COUNTING MEMBERS OF A SET: Midyear Inventory

Kindergarten	Experimental Classes						Comparison Classes	
							Socio-Economic	Curriculum
	a	c	d	e	f	g	f'	g'
N of Pupils	19	44	27	28	25	27	23	27
Range: Correct Responses	0-8	0-8	0-8	0-8	1-8	0-8	0-8	0-8
Mean	4.21	5.07	6.41	5.86	5.72	6.15	5.70	6.52
S. D.	2.91	2.96	2.10	2.86	2.41	2.07	2.80	2.22

Possible Correct = 8

TABLE 48

COUNTING MEMBERS OF A SET: Midyear Inventory

First Grade	Experimental Classes								Comparison Classes	
									Socio-Economic	Curriculum
	A	B	C	D	E	F	G	H	G'	H'
N of Pupils	32	35	25	24	25	28	25	19	24	24
Range: Correct Responses	0-8	0-8	0-8	5-8	all8	1-8	3-8	5-8	4-8	0-8
Mean	7.03	6.26	6.96	7.38	8.00	6.75	7.08	7.32	7.46	7.33
S. D.	1.78	2.22	2.05	0.95	0.00	1.74	1.49	0.98	1.15	1.70

Possible Correct = 8

At this point in the school year, there are no significant differences between the performance of the experimental and comparison samples on counting members of a set as demonstrated in Table 49. Since this dimension of counting was not tested at the beginning of the school year, it is not possible to note any rate of change. It is, however, important to point out that the experimental group is able to perform as well on this task as the comparison groups at midyear despite their poorer performance on other counting tasks on the Initial Inventory.

TABLE 49

DIFFERENCES BETWEEN SAMPLE MEANS ON COUNTING MEMBERS OF A SET: Midyear Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	5.584		6.520	170, 27	-1.729	n.s.
	5.584	5.700		170, 23	-0.194	n.s.
		5.700	6.520	23, 27	-1.131	n.s.
First Grade	7.043		7.330	213, 24	-0.788	n.s.
	7.043	7.460		213, 24	-1.179	n.s.
		7.460	7.330	24, 24	0.304	n.s.

d. **Number Symbols-Recognition**

Recognition of written numerals is another of the assessments made at the beginning of the school year and extended, for the first grades, on the Midyear Inventory. On the Initial Inventory the numerals included for identification were zero through nine. On the Midyear Inventory the identification of numerals included a sampling of numerals through nineteen.[15]

TABLE 50

NUMBER SYMBOLS - RECOGNITION: Midyear Inventory

First Grade	Experimental Classes								Comparison Classes	
									Socio-Economic	Curriculum
	A	B	C	D	E	F	G	H	G'	H'
N of Pupils	32	35	25	24	25	28	25	19	24	24
Range: Correct Responses	2-8	0-8	2-8	3-8	4-8	0-8	2-8	1-8	6-8	7-8
Mean	6.88	6.20	7.24	7.54	7.12	6.96	6.84	6.26	7.79	7.96
S. D.	1.83	2.67	1.77	1.19	1.34	2.06	1.91	1.89	0.50	0.20

Possible Correct = 8

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[15] See Appendix C, page 119, for instructions.

Of the eight possible correct responses, the means for the experimental first grade classes ranged from 6.20 to 7.54 as can be seen in Table 50. The means of the comparison classes are 7.79 and 7.96, respectively. The differences are more apparent when the standard deviations are examined, with the sigmas of the experimental classes considerably larger than are those of the comparison classes.

TABLE 51

DIFFERENCES BETWEEN SAMPLE MEANS ON
NUMBER SYMBOLS-RECOGNITION: Midyear Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
First Grade	6.864		7.960	213, 24	-2.696	.01
	6.864	7.790		213, 24	-2.271	n.s.(.05)
		7.790	7.960	24, 24	-1.514	n.s.

The difference between the means of the experimental sample and the curriculum comparison class is significant at the .01 level as Table 51 shows. The difference between the experimental and socio-economic comparison group does not reach the accepted significance level. By contrast, on the Initial Inventory, the differences between the experimental sample and both comparison samples had been significant at the .001 level on Recognition of Number Symbols. The experimental first graders have gained from a mean of 5.538 in September to 6.864 in January which suggests a good rate of improvement. On this Midyear Inventory, the performance of the comparison groups might have been higher, as on other number concept results, had there been more items on the test. This limitation on number of items included within a given assessment was recognized when the tests were developed. The problem, however, was one of testing, even with a small number of items, a wide variety of mathematics-related abilities within a feasible time period for administering individual tests.

e. Number Symbols - Marking

Marking Number Symbols, like Counting Buttons, is an assessment that was given in the Initial Inventory and administered again to the first grades in the Midyear Inventory to measure change over the first half of the school year. It was not given to the kindergarten children at this time because writing numerals is not a skill stressed in the SMSG curriculum at the kindergarten level.

The results for the first grade classes are presented in Table 52. For both comparison classes (G' and H') writing the numerals asked presented little difficulty. In class G', all of the children wrote correctly either six or seven of the seven included in this assessment, while there were still children in the experimental classes (A, B, G) who could write correctly none of the number symbols requested in this test.

TABLE 52

NUMBER SYMBOLS-MARKING: Midyear Inventory

First Grade	Experimental Classes								Comparison Classes	
									Socio-Economic	Curriculum
	A	B	C	D	E	F	G	H	G'	H'
N of Pupils	32	35	25	24	25	28	25	19	24	24
Range: Correct Responses	0-7	0-7	3-7	2-7	1-7	1-7	0-7	2-7	6-7	4-7
Mean	6.25	5.66	6.16	6.21	4.96	6.04	5.88	5.95	6.96	6.71
S. D.	1.46	2.29	1.32	1.38	1.56	1.84	1.68	1.43	0.20	0.68

Possible Correct = 7

Table 53 shows the differences between the sample means on Marking Number Symbols. Although the socio-economic comparison class mean is significantly higher than the experimental sample's ($t = -3.019$, $p < .01$), the difference is not as great at this point in the school year as it was at the time of administering the Initial Inventory ($t = -9.846$, $p < .001$). The difference between the means of the experimental and curriculum comparison groups does not reach the accepted level of significance although the difference is in the direction of better performance of the curriculum comparison class.

TABLE 53

DIFFERENCES BETWEEN SAMPLE MEANS
ON NUMBER SYMBOLS - MARKING: Midyear Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
First Grade	5.889		6.710	213, 24	-2.296	n.s.(.05)
	5.889	6.960		213, 24	-3.019	.01
		6.960	6.710	24, 24	1.692	n.s.

In interpreting these findings, it is important to consider the amount of improvement in performance of the disadvantaged children independent of the comparison to the other two samples included in the study. The mean number of numerals written correctly by the experimental first grade sample on the Initial Inventory was 2.555; on the Midyear Inventory 5.889. This is a noteworthy improvement even allowing for this being a test-retest situation. The test was not difficult enough to allow for testing the limits of the comparison groups. This limitation does not permit their progress to be fairly demonstrated.

5. Ordering and Classifying

Children must perceive objects about them and then begin both to discriminate differences and generalize similar attributes of these objects. This is the process by which concepts are thought to develop.[16] These basic concepts, in turn, enable children to deal with the world and to develop more sophisticated concepts.

As a measure of one kind of concept development, ordering a set of geometric regions by size and classifying them on the basis of color and shape were employed in the Midyear Inventory[17] and again in the Final Inventory. The children were not required to verbalize similarities among the objects as is the pattern in some tests of concept development; rather, they were requested to select specified geometric shapes with certain attributes from a larger set of such shapes.

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[16] Sigel, I. E., The attainment of Concepts, in Hoffman, M. L. and Hoffman, Lois W., Review of Child Development Research, Vol. 1. New York: Russell Sage Foundation, 1964. pp. 209-248.

[17] See Appendix C, pages 126-128, for instructions and materials on Ordering and Classifying.

The materials included four kinds of geometric regions: circle, square, triangle, rectangle. These were made of cardboard, each shape in four different colors and in four different sizes. A specified set of various shapes, colors, and sizes was spread out in front of the child, and he was asked to find all the shapes that were, for example, triangles. This is a classifying task. An example of an ordering task is requesting the child to place a set of four triangles, each of a different size, in a line from the smallest to the largest. A task which requires both ordering and classification is asking the child to select the smallest circular shape from a set including larger circular regions as well as other shapes.

TABLE 54

ORDERING AND CLASSIFYING: Midyear Inventory

		Experimental	Comparison	
			Socio-Econ.	Curric.
Kindergarten	N	167	23	25
	Range	0-7	2-7	1-7
	Mean	4.77	4.91	4.52
	S.D.	1.81	1.28	1.43
First Grade	N	239	27	22
	Range	1-7	4-7	3-7
	Mean	5.06	5.56	5.68
	S.D.	1.56	1.62	1.11

Possible Correct = 7

The results presented in Table 54 show little difference between the groups on a combined score for ordering and classifying at the middle of the school year. It may be noted that the results in the above table are not presented separately for each classroom in the experimental sample as they have been in previous tables. Since there were only two ordering items, two classifying items, and three which required both ordering and classifying, these items were combined, across items and across classrooms, for presentation.

Although there are no significant differences between the means of the various samples, as can be seen in Table 55, below, the range of scores (Table 54) is greatest for the experimental sample at first grade as well as at kindergarten, a trend which has been observed in many of the results previously presented.

TABLE 55

DIFFERENCES BETWEEN SAMPLE MEANS ON ORDERING AND CLASSIFYING: Midyear Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kinder-garten	4.770		4.500	167, 25	0.675	n.s.
	4.770	4.910		167, 23	-0.357	n.s.
		4.910	4.520	23, 25	-0.971	n.s.
First Grade	5.060		5.680	239, 22	-1.815	n.s.
	5.060	5.560		239, 27	-1.566	n.s.
		5.560	5.680	27, 22	0.289	n.s.

If the difference between means at kindergarten and at first grade is thought of as a rate of development index, then the experimental sample is progressing at a slower rate than either comparison class. For the experimental sample the absolute difference between the kindergarten and first grade mean is .29, while for the socio-economic comparison class it is .65, and for the curriculum comparison class, 1.16. To understand the more rapid rate of the curriculum comparison class will require more information on the background of these children and further analysis of the curriculum being taught.

VIII RESULTS AND DISCUSSION: FINAL INVENTORY

To use a typical experimental paradigm, the present study could be diagramed as follows:

<table>
<tr><td>School Year</td><td>September</td><td>January</td><td>June</td></tr>
<tr><td rowspan="2">Treatment</td><td colspan="3">←—— SMSG Experimental Program ——→
(Disadvantaged and Socio-economic Comparison)</td></tr>
<tr><td colspan="3">←—— Non-SMSG Curriculum ——→
(Curriculum Comparison)</td></tr>
<tr><td>Evaluation of Treatment Effects</td><td>Pre-test
(Initial Inventory)</td><td>(Midyear Inventory)</td><td>Post-test
(Final Inventory)</td></tr>
</table>

The Initial Inventory was a pre-test in that its purpose was the measurement of both readiness to learn mathematical concepts and of previous learning. The Midyear Inventory was an assessment of progress, while the Final Inventory may be viewed as a post-test of the year's program effects.

The test format of the Final Inventory was the same as that of the previous inventories. Some of the assessments were repeated from the earlier tests, some modified to provide alternative forms, and others extended to test developing skills or knowledge.

In presenting the results of the Final Inventory, comparisons will also be made to the children's performance on the tests administered earlier in the school year. One further note concerning the Final Inventory concerns the smaller number of classes for whom test findings are presented. One metropolitan area was unable to administer the Final Inventory. Therefore, two kindergarten and two first grade classes within the experimental sample and one class at each grade level within the socio-economic comparison sample had to be excluded.

1. Visual Memory

a. Objects

The test of visual memory for objects is a modified form of that given in the Initial Inventory. The familiar objects used were the same as those employed originally. The composition of the sets of objects for each of the items was changed, however, as was the object removed.

TABLE 56

VISUAL MEMORY - OBJECTS: Final Inventory

First Recall Responses

Kindergarten	Experimental Classes					Comparison	
						Socio-Econ.	Curriculum
	c	d	e	f	g	f'	g'
N	44	27	28	25	27	23	27
Range: Correct Responses	2-5	2-5	0-5	2-5	0-5	2-5	2-5
Mean	3.80	3.70	3.96	3.44	3.30	3.57	4.26
S.D.	1.01	0.97	1.45	0.80	1.49	1.10	0.93

Possible Correct = 5

TABLE 57

VISUAL MEMORY - OBJECTS: Final Inventory

First Recall Responses

First Grade	Experimental Classes						Comparison	
							Socio-Econ.	Curriculum
	C	D	E	F	G	H	G'	H'
N	25	24	25	28	25	19	24	24
Range: Correct Responses	2-5	2-5	3-5	2-5	1-5	2-5	2-5	0-5
Mean	3.68	3.75	4.64	3.86	3.36	3.68	3.38	4.08
S.D.	0.88	0.88	0.69	0.74	0.89	0.86	0.90	1.15

Possible Correct = 5

Tables 56 and 57 above show the class means and standard deviations for the first recall responses. It is interesting to note in comparing these two tables that, although the range is slightly more extended for two of the experimental kindergarten classes (e and g), the means of the experimental kindergarten and first grade samples are very similar (3.663 and 3.836, respectively). This similarity in means is apparent for the two comparison groups as well. On Visual Memory in the Initial Inventory,[18] the socio-economic comparison first grades performed slightly better than did the comparable kindergartens, although the curriculum comparison kindergarten and first grade were the same. There was, however, a clear difference between the experimental kindergartens and first grades with the first grade children having higher mean scores. What this suggests is that the experimental kindergarten children have improved considerably in this measure of visual memory over the school year, from a sample mean of 2.637 on the Initial to 3.663 on the Final Inventory. This does not imply that the first grade experimental classes have not improved in performance, their class means are higher and the standard deviations smaller than at the beginning of the school year, with the sample means being 3.168 on the Initial and 3.836 on the Final Inventory.

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[18] For the relevant tables on Visual Memory, Initial Inventory, see pp. 20 and 21.

TABLE 58

DIFFERENCES BETWEEN SAMPLE MEANS ON VISUAL MEMORY - OBJECTS: Final Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	3.663		4.260	151, 27	-2.542	n.s. (.02)
	3.663	3.570		157, 23	0.362	n.s.
		3.570	4.260	23, 27	2.355	n.s. (.02)
First Grade	3.836		4.080	146, 24	-1.260	n.s.
	3.836	3.380		146, 24	2.474	n.s. (.02)
		3.380	4.080	24, 24	2.299	n.s. (.05)

Table 58 shows the values of t for the differences between the sample means on the Final Inventory for Visual Memory Objects. The performance of the curriculum comparison kindergarten class, although still superior to that of the experimental kindergarten sample, does not attain the accepted significance level of .01. On the Initial Inventory the difference was significant at the .001 level, however. This narrowing of the gap in performance over the school year supports the concept of intervention with special programs during the earliest public school experiences.

An alternative interpretation which could be made for the above finding is that the children in the experimental sample were becoming more familiar with and better able to perform in the test situation. If this were the case, then the experimental first graders would also have shown marked improvement over the year in relation to the same comparison group, i.e., the curriculum comparison class. This is not what the means and t's show, however. The performance of the experimental first graders was as discrepant from the curriculum comparison first grade at the end of the school year as it was at the beginning, the means of the curriculum comparison first grade being higher at each testing with the differences attaining the .05 level both times.

Another finding which is worthy of mention is that the experimental first grade sample is not significantly better than the socio-economic first grade class at the end of the school year, as can be seen in Table 58, although its mean was significantly higher ($p < .01$) on the Initial Inventory. One possible explanation for this finding is that the SMSG first grade program did not provide experiences which would develop the children's ability to manage visual memory tasks, while the kindergarten program did. Another possible explanation is that, in spite of superior performance at the beginning of the school year, the experimental first graders are working at an ever-increasing disadvantage by comparison to the higher socio-economic group of children. This again suggests the possibility for greater success if special programs dealing with help in mediating responses, along with other kinds of training, are begun at an earlier age.

b. Pictures

Just as in Object Recognition, where giving names to concrete objects, giving names to photographs and then to drawings of such objects were considered tasks of increasing difficulty, so the memory of drawings was considered a more complex task, and an extension of, visual memory for objects.

Visual Memory, Pictures,[19] was given on the Final Inventory only. It consisted of booklets with drawings, such as are used in the SMSG Pupil Books, printed in a row. The practice set consisted of two pictures; a railroad engine and a fish. The four test items consisted of sets of four, then five drawings. The administration was very similar to that of Visual Memory - Objects. The first page of the booklet consisted of the original set; the next page consisted of a set with one drawing missing. If the child could not recall the missing drawing after three questions, the third page of the booklet was presented to him. This last page contained the missing drawing within a new set of drawings and was scored for recognition.

The class means and sigmas for first recall responses for the kindergartens are presented in Table 59 and for the first grades in Table 60.

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[19] See Appendix C, page 106 for instructions.

TABLE 59

VISUAL MEMORY - PICTURES: Final Inventory

First Recall Responses

Kindergarten	Experimental Classes					Comparison	
						Socio-Econ.	Curriculum
	c	d	e	f	g	f'	g'
N	44	29	28	25	27	23	27
Range: Correct Responses	0-4	0-4	0-3	0-3	0-4	0-4	1-4
Mean	1.66	1.48	0.79	1.24	1.81	1.61	2.52
S.D.	1.24	1.10	0.77	0.86	1.22	1.28	1.07

Possible Correct = 4

TABLE 60

VISUAL MEMORY - PICTURES: Final Inventory

First Recall Responses

First Grade	Experimental Classes						Comparison	
							Socio-Econ.	Curri ulum
	C	D	E	F	G	H	G'	H'
N	25	24	25	28	25	19	24	24
Range: Correct Responses	0-4	0-3	0-4	0-3	0-3	0-4	0-3	1-4
Mean	1.68	1.21	2.80	1.86	1.36	1.79	1.25	2.21
S.D.	1.12	0.96	1.06	0.74	1.02	1.32	0.92	0.96

Possible Correct = 4

Inspection of the above tables shows that immediate recall of a drawing which was seen and then removed is a difficult task. Performance on this task is considerably poorer across classes than on the Visual Memory, Objects. It is recognized that this is a new test for the children while the visual memory, objects, at the end of the year was a retest from the Initial Inventory. With this in mind, the means of the poorest and best performing classes on each of the Visual Memory tasks was noted, regardless of whether they were in the experimental or comparison group.

TABLE 61

PERCENTAGE OF CORRECT RESPONSES ON
VISUAL MEMORY ASSESSMENTS FOR POOREST AND BEST PERFORMING CLASSES

		Objects--Initial	Class	Objects--Final	Class	Pictures--Final	Class
Poorest Performing	Kindergarten	44.0%	g	66.6%	g	19.7%	e
	First Grade	50.0%	D	67.2%	G	30.2%	D
Best Performing	Kindergarten	76.0%	g'	85.2%	g'	63.0%	g'
	First Grade	76.0%	G'+H'	92.8%	H'	70.0%	E

As Table 61 shows, for the classes that performed least well on each of these visual memory tasks, the pictures were clearly much more difficult to recall than were the objects. For the best performing classes the discrepancy is not as great but the trend is the same as for the classes that perform least well, with the pictures being more difficult to recall than the objects.

The differences between sample means are presented in Table 62 below. The curriculum comparison kindergarten class shows significantly better performance on these first recall responses than either the experimental or socioeconomic comparison kindergarten groups. It is also noteworthy that this curriculum comparison kindergarten performs better than any of the first grade groups, its mean being 2.520, and the curriculum comparison first grade mean, the highest of the three first grade groups, being 2.210.

TABLE 62

DIFFERENCES BETWEEN SAMPLE MEANS ON VISUAL MEMORY PICTURES:
Final Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	1.425		2.520	153,27	-4.743	.001
	1.425	1.610		153,23	-0.728	n.s.
		1.610	2.520	23,27	2.683	.01
First Grade	1.789		2.210	146,24	-1.881	n.s.
	1.789	1.250		146,24	2.421	n.s.(.02)
		1.250	2.210	24,24	3.463	.01

It is interesting to note that the first grade means for both the curriculum and socio-economic comparison samples are lower than for their kindergarten counterparts. This is not the trend for the experimental sample, however. It may be that immediate recall is related to eidetic imagery, a phenomenon that is observed more frequently in younger children and is less likely seen in older children. This interpretation would suggest that the experimental children are at a less advanced developmental stage than the two comparison groups on this particular phenomenon. It would further suggest that the visual memory of a more thoughtful, longer delayed nature might be more frequently observed as the immediate, eidetic imagery drops out. This latter interpretation can be formulated as a hypothesis and will be tested by future analysis of the second and third recall responses, as well as the recognition responses to the Visual Memory, Picture, task.

2. Color Inventory

The test used for the children's knowledge of color in the Initial Inventory[20] contained three parts: Matching, Naming, Identifying. On the Final Inventory, the Naming and Identifying portions were repeated. The matching section was omitted even though the experimental kindergarten children had performed significantly less well than the curriculum comparison kindergarten class ($p < .01$), and the first grade experimental sample had performed significantly less well than had the socio-economic comparison sample ($p < .01$) on the Initial Inventory. The reason for omitting the Matching section was that, despite these significant differences, the experimental classes had performed well on this portion of the color assessment by comparison to their performance on the Naming and Identifying. Out of a possible score of six in the Matching section, the experimental kindergarten sample mean was 5.438 and the experimental first grade sample mean 5.627.

By the end of the school year, the performance of the experimental kindergarten classes is very similar to that of the comparison classes on both Naming and Identifying, as can be seen in Table 63. The standard deviations of the experimental kindergartens on Naming still tend to be greater than for the

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[20] See pp. 23-25 for the Initial Color Inventory results.

TABLE 63

COLOR INVENTORY : Final Inventory

Kindergarten		Experimental Classes					Comparison	
							Socio-Econ.	Curriculum
		c	d	e	f	g	f'	g'
NAMING Possible Correct-7	N	44	27	28	25	27	25	27
	Range: Correct Responses	0-7	4-7	1-7	5-7	4-7	1-7	1-7
	Mean	6.55	6.70	6.43	6.92	6.33	6.92	6.22
	S.D.	1.18	0.71	1.42	0.39	0.90	0.39	1.42
IDENTI-FYING Possible Correct-6	N	44	27	28	25	27	23	27
	Range: Correct Responses	4-6	4-6	0-6	all 6	4-6	0-6	3-6
	Mean	5.59	5.93	5.64	6.00	5.41	5.74	5.56
	S.D.	0.78	0.38	1.17	0.00	0.83	1.22	0.96

higher socio-economic level kindergarten, but not greater than the sigma of the curriculum comparison kindergarten. Also, the sigmas for the experimental kindergartens are considerably smaller on both Naming and Identifying than they were at the beginning of the school year. It seems clear that the rate of learning of color names and using them to identify objects has been rapid for the experimental kindergarten children. Class g performed least well of the experimental kindergartens on the Initial Inventory on Color Naming and Identifying, with means of 3.93 and 3.33, respectively. On the Final Inventory, although this class still had the lowest mean of the experimental kindergarten classes, the absolute gain over the year was considerable, with the Final Inventory means of class g being 6.33 for Naming and 5.41 for Identifying.

TABLE 64

DIFFERENCES BETWEEN SAMPLE MEANS ON COLOR INVENTORY: Final Inventory

Kindergarten	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
NAMING	6.576		6.220	151,27	1.517	n.s.
	6.576	6.920		151,25	-1.606	n.s.
		6.920	6.220	25,27	-2.337	n.s.(.05)
IDENTIFYING	5.696		5.560	151,27	0.806	n.s.
	5.696	5.740		151,23	-0.232	n.s.
		5.740	5.560	23,27	-0.572	n.s.

As can be observed in Table 64 above, the experimental kindergarten sample is not significantly different from either comparison sample on naming or identifying colors by the end of the school year, whereas their performance had been significantly poorer than the higher socio-economic sample ($p < .001$ on Naming and $< .01$ on Identifying) at the beginning of the school year.

The first grade classes show the same trend as the kindergartens, as can be seen in Table 65.

TABLE 65

COLOR INVENTORY : Final Inventory

First Grade		Experimental Classes						Comparison	
								Socio-Econ.	Curriculum
		C	D	E	F	G	H	G'	H'
NAMING	N	25	24	25	28	25	19	24	24
	Range: Correct Responses	4-7	3-7	all 7	all 7	1-7	all 7	all 7	6-7
Possible Correct=7	Mean	6.72	6.63	7.00	7.00	6.60	7.00	7.00	6.96
	S.D.	0.72	0.90	0.00	0.00	1.23	0.00	0.00	0.20
IDENTIFY-ING	N	25	24	25	28	25	19	24	24
	Range: Correct Responses	4-6	2-6	all 6	all 6	1-6	all 6	all 6	all 6
Possible Correct=6	Mean	5.72	5.58	6.00	6.00	5.76	6.00	6.00	6.00
	S.D.	0.60	1.15	0.00	0.00	0.99	0.00	0.00	0.00

It is readily apparent, from observation of Table 65, by the end of the school year giving color names and identifying objects by their color are simple tasks, as they have been measured. Yet, there are children in classes D and G who can name or identify only one or two of the colors. There are not enough of these children to make the sample means significantly different, as can be seen in Table 66, but there are clearly children within the disadvantaged sample who need considerably more help even on tasks which are apparently simple ones.

TABLE 66

DIFFERENCES BETWEEN SAMPLE MEANS ON COLOR INVENTORY:
Final Inventory

First Grade	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
NAMING	6.823		6.960	146,24	-0.954	n.s.
	6.823	7.000		146,24	-1.240	n.s.
		7.000	6.960	24,24	-0.959	n.s.
IDENTIFYING	5.842		6.000	146,24	-1.154	n.s.
	5.842	6.000		146,24	-1.154	n.s.
		6.000	6.000	24,24	---	---

Given the fact that the Color Inventory did not discriminate for either the socio-economic or the curriculum comparison first grade classes at the end of the year (Table 65 and 66), it is still important to recognize the gains through the school year made by the experimental children. To evaluate what differences on these dimensions of color usage remain between samples at the end of the school year, the test will need to be made more difficult and, therefore, more discriminating.

3. Geometric Shapes

The assessment of the children's knowledge of geometric shapes at the end of the school year was a repeat of the Naming and Identifying sections of the midyear test. As with the Color Inventory, the Matching portion was omitted because the performance of the experimental sample as well as of the comparison samples had been very good on the Midyear Inventory.[21]

TABLE 67

GEOMETRIC SHAPES: Final Inventory

Kindergarten		Experimental Classes					Comparison	
							Socio-Econ.	Curriculum
		c	d	e	f	g	f'	g'
NAMING Possible Correct=4	N	44	27	28	25	27	23	27
	Range: Correct Responses	0-4	2-4	1-4	2-4	2-4	0-4	0-3
	Mean	3.18	3.78	3.71	3.80	3.41	3.35	2.04
	S.D.	1.13	0.50	0.80	0.57	0.68	0.91	0.96
IDENTIFYING Possible Correct=4	N	44	27	28	25	27	23	27
	Range: Correct Responses	1-4	2-4	2-4	2-4	2-4	0-4	2-4
	Mean	3.52	3.56	3.89	3.88	3.37	3.74	3.07
	S.D.	0.94	0.83	0.41	0.43	0.82	0.90	0.94

In Table 67 the means and standard deviations for the kindergarten classes are presented. By comparison to the midyear results on Naming, the means of the experimental classes on the Final Inventory are considerably higher, as is the mean of the curriculum comparison class. The mean for the socio-economic comparison class remained relatively unchanged from the Midyear Inventory. In addition, the standard deviations of the experimental kindergartens, on Naming, with the exception of Class c, have become noticeably smaller.

The trend is similar on Identifying for the kindergarten classes although, on this part, the mean of the socio-economic comparison class, like the other samples, is higher on the Final Inventory.

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[21] For the results on Geometric Shapes - Midyear Inventory, see p. 38.

TABLE 68

GEOMETRIC SHAPES: Final Inventory

First Grade		Experimental Classes						Comparison	
								Socio-Econ.	Curriculum
		C	D	E	F	G	H	G'	H'
NAMING Possible Correct = 4	N	25	24	25	28	25	19	24	24
	Range: Correct Responses	1-4	0-4	2-4	1-4	1-4	1-4	2-4	0-4
	Mean	3.20	2.79	3.76	3.50	2.96	3.37	3.33	2.96
	S.D.	0.94	1.08	0.59	0.87	0.96	0.87	0.85	1.06
IDENTIFYING Possible Correct = 4	N	25	24	25	28	25	19	24	24
	Range: Correct Responses	1-4	2-4	3-4	2-4	2-4	2-4	2-4	2-4
	Mean	3.72	3.58	3.96	3.93	3.60	3.89	3.83	3.83
	S.D.	0.78	0.76	0.20	0.37	0.69	0.45	0.47	0.47

The results for the first grades, presented in Table 68, show a similar pattern of change as observed in the kindergarten classes, with higher means and smaller standard deviations at the end of the school year than at midyear.

TABLE 69

DIFFERENCES BETWEEN SAMPLE MEANS ON GEOMETRIC SHAPES: Final Inventory

		Sample Means			N	t	Signif. Level
		Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	NAMING	3.529		2.040	151, 27	7.961	.001
		3.529	3.350		151, 23	0.902	n.s.
			3.350	2.040	23, 27	-4.826	.001
	IDENTIFYING	3.629		3.070	151, 27	3.286	.01
		3.629	3.740		151, 23	-0.616	n.s.
			3.740	3.070	23, 27	-2.510	n.s.(.02)
First Grade	NAMING	3.267		2.960	146, 24	1.505	n.s.
		3.267	3.330		146, 24	-0.320	n.s.
			3.330	2.960	24, 24	-1.306	n.s.
	IDENTIFYING	3.780		3.830	146, 24	-0.398	n.s.
		3.780	3.830		146, 24	-0.398	n.s.
			3.830	3.830	24, 24	---	---

The differences between sample means presented in Table 69 show the experimental kindergarten sample performing significantly better on both the Naming and Identifying portions of the Geometric Shapes assessment than the curriculum comparison class, this despite the fact that understanding that objects of different shapes have different names is included in the curriculum of the non-SMSG comparison class. The emphasis on geometric shapes within the comparison curriculum may be less, however, than in the kindergarten SMSG program. These significant differences between the experimental sample and the curriculum comparison class, with the better performance of the experimental kindergarten sample ($p < .001$) were also found on the Midyear Inventory on both Naming and Identifying. The experimental kindergarten children were not significantly different from the socio-economic comparison class at midyear on naming and identification of the geometric shapes tested. The results of the Final Inventory show this same lack of difference between the two groups.

The results for the first grade samples show a pattern different from that of the kindergartens. Although the mean of the experimental first grade sample on Naming was significantly higher ($p < .01$) than the curriculum comparison class at midyear, there is no difference on the Final Inventory, as can be seen in Table 69. On the other hand, the performance of the socio-economic comparison class at the middle of the school year was significantly better ($p < .001$) than that of the experimental group on Naming. By the final testing, this difference has also disappeared. Thus, the means of the three first grade groups have moved very close together on the Naming portion of the Final Inventory.

This change from differences between the first grade samples at midyear to similar performance at the end of the school year is apparent for Identifying as well as for Naming. The differences on Identifying at the Midyear Inventory were not as great as were those on Naming but were in the same direction, with the socio-economic comparison class performing significantly better ($p < .001$) than the curriculum comparison class and almost significantly better ($p < .02$) than the experimental sample, although no difference obtained between the experimental and curriculum comparison groups. On the Final Inventory the means of the three groups are very similar as can be observed in Table 69.

The results strongly suggest that there is no problem for the disadvantaged children in learning the basic ideas of geometry as presented in current mathematics curricula. The findings that the experimental kindergarten children, by the middle of the school year, have learned enough of these geometric concepts to perform the same as more advantaged children and can continue to do so at the end of the school year implies that some earlier lacks may be compensated for in a relatively short time. It is recognized that no testing of knowledge of geometric shapes was included in the Initial Inventory; therefore, no measure of discrepancy between the disadvantaged and higher socio-economic group at the start of school is available. It seems safe to assume, however, that with the other kinds of differences found at the beginning of the school year, the performance of the disadvantaged kindergarteners would have been lower than that of the socio-economic comparison group.

For the first grade experimental children, the improvement in performance between the middle and end of the school year is also noteworthy. Both the SMSG experimental sample and the curriculum comparison group showed considerable gains in performance. The higher socio-economic class, with good performance on Geometric Shapes at midyear, showed little change between midyear and end of the year scores. Whether the gains made by the disadvantaged children can be maintained over time can only be evaluated by a more prolonged follow-up of the children.

4. Number Concepts

a. Counting of Objects

The Counting Buttons task was given to the children at the beginning and middle of the school year. It was repeated on the Final Inventory with the kindergarten classes only. Table 70 shows the class means and standard deviations for this final testing.

TABLE 70

COUNTING BUTTONS: Final Inventory

Kindergarten	Experimental Classes					Comparison	
						Socio-Econ.	Curriculum
	c	d	e	f	g	f'	g'
N	44	27	28	25	27	23	27
Range: Correct Responses	0-7	0-7	0-7	3-7	3-7	1-7	4-7
Mean	5.50	6.15	5.86	6.40	6.11	6.09	6.78
S.D.	1.90	1.69	2.13	1.23	1.07	2.00	0.68

Possible Correct = 7

In comparing the class means on the Final Inventory with those of the Initial and Midyear inventories,[22] progressively higher performance is apparent for all of the classes, not an astonishing finding. The amount of change and the decrease in the size of the standard deviations are more deserving of mention. The mean of Class f on the Final Inventory, 6.40, is the highest of the five experimental classes. At the beginning of the school year, the mean of this class was 2.24, next to the lowest--an increase of 4.16 over the year. For the class with the lowest mean on the Final Inventory, Class c, the gain over the year was 2.05. In addition to the unmeasured teacher variables, one variable which might be operating here is size of class. With 44 children in a kindergarten class as is the case in Class c, one could speculate that, given a fine curriculum and an excellent teacher, the learning rate on specific content might be different for this class than for a class of 25 children.

The curriculum comparison class (g') has clearly made great strides in counting, as evidenced by the mean and the very small standard deviation. Counting, number names, and sequence of these are all stressed within the particular curriculum used by this kindergarten class. The difference between class g' and the experimental sample attains the .02 level of significance, as can be seen in Table 71. It, therefore, approaches, but does not reach the accepted significance level of .01. Also, it may be noted in this table that there is no significant difference between the experimental kindergarten sample and the socio-economic comparison class.

TABLE 71

DIFFERENCES BETWEEN SAMPLE MEANS ON COUNTING BUTTONS: Final Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	5.941		6.780	151,27	-2.469	n.s. (.02)
	5.941	6.090		151,23	-0.374	n.s.
		6.090	6.780	23,27	1.648	n.s.

These findings are in contrast to the differences obtained in the Initial Inventory, at which time the disadvantaged children showed significantly poorer performance on this counting task than both of the comparison groups. By midyear, these differences had disappeared. That a difference, approaching significance (.02), appears on the Final Inventory between the experimental and the curriculum comparison kindergartens suggests the difference between curricula in emphasis upon counting at this age level.

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[22] For the results on Counting Buttons-Initial Inventory, see pp. 26-27, and for Midyear Inventory, pp. 44-45.

b. Counting Members of a Set

This counting task is a repeat of one given on the Midyear Inventory. The following two tables, 72 and 73, present the means and standard deviations for the kindergarten and first grade classes, respectively.

TABLE 72

COUNTING MEMBERS OF A SET: Final Inventory

Kindergarten	Experimental Classes					Comparison	
						Socio-Econ.	Curriculum
	c	d	e	f	g	f'	g'
N	44	27	28	25	27	23	27
Range: Correct Responses	0-8	0-8	0-8	2-8	0-8	0-8	4-8
Mean	6.30	6.78	6.68	6.80	7.22	6.04	7.30
S.D.	1.91	2.11	2.19	1.62	1.59	2.29	1.12

Possible Correct = 8

TABLE 73

COUNTING MEMBERS OF A SET: Final Inventory

First Grade	Experimental Classes						Comparison	
							Socio-Econ.	Curriculum
	C	D	E	F	G	H	G'	H'
N	25	24	25	28	25	19	24	24
Range: Correct Responses	4-8	5-8	all 8	7-8	0-8	5-8	0-8	6-8
Mean	7.20	7.46	8.00	7.96	6.96	7.79	6.83	7.88
S.D.	1.06	0.76	0.00	0.19	1.59	0.69	1.82	0.44

Possible Correct = 8

Table 73 shows that, for the first grade children, this is a relatively simple test although it should be mentioned that there are children in both classes G and G' who could count none of the set cards correctly. For the kindergarten classes (Table 72) there are children in four of the five experimental kindergartens as well as in the socio-economic comparison class (f') who could not do any of these counting items correctly. The increase in means from the Midyear Inventory[23] is, however, at least 1.0 in each of the kindergarten classes, and the standard deviations, in all classes, are smaller at the end of the school year.

TABLE 74

DIFFERENCES BETWEEN SAMPLE MEANS ON COUNTING MEMBERS OF A SET: Final Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	6.704		7.300	151,27	-1.563	n.s.
	6.704	6.040		151,23	1.500	n.s.
		6.040	7.300	23,27	2.475	n.s. (.02)
First Grade	7.561		7.880	146,24	-1.721	n.s.
	7.561	6.830		146,24	3.090	.01
		6.830	7.880	24,24	2.689	.01

The sample means, presented in Table 74, show the performance of the experimental kindergarten sample to be no different from either of the two comparison classes. For the first grades, although there is no difference between the means of the experimental and curriculum comparison groups, the experimental children perform significantly better ($p < .01$) than the socio-economic comparison class. This is a promising finding, not in the fact of the disadvantaged children out-performing the more advantaged children, but in demonstrating their potential for learning, given appropriate help.

It is important to note that there were no significant differences between any of the groups at either the kindergarten or first grade on counting members of a set at midyear. Thus, the performances of the experimental children, relative to the comparison classes, has been maintained. It is difficult to interpret the findings on the relatively lower performance of the socio-economic comparison class at the end of the school year. For the first grade class there was a drop in mean from 7.460 at midyear to 6.830 on the Final Inventory, a phenomenon not seen for any of the other groups.

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[23] For the results on Counting Members of a Set, Midyear Inventory, see p. 47.

c. Rote Counting

As in the Initial Inventory, rote counting was assessed by asking the child to count. If he did not start spontaneously upon this request, the tester started counting and asked the child to continue. Scoring, in the tables to follow, is the same as was used in the Initial Inventory.[24]

TABLE 75

ROTE COUNTING: Final Inventory

Kindergarten	Experimental Classes					Comparison Classes	
						Socio-Economic	Curriculum
	c	d	e	f	g	f'	g'
N of Pupils	43	27	26	25	27	23	27
Range: Correct Responses	0-8	0-8	0-8	1-5	0-8	0-8	1-8
Mean	2.72	3.56	2.81	2.72	2.30	2.39	2.91
S. D.	1.92	2.42	1.82	1.37	2.05	1.81	2.00

Possible Correct = 8

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[24] For the scoring system used and results of Rote Counting in the initial inventory, see pages 29-31.

TABLE 76

ROTE COUNTING: Final Inventory

First Grade	Experimental Classes						Comparison Classes	
							Socio-Economic	Curriculum
	C	D	E	F	G	H	G'	H'
N of Pupils	25	24	27	30	26	23	28	24
Range: Correct Responses	0-8	1-8	0-8	1-8	0-8	1-8	2-8	2-8
Mean	5.24	3.63	4.26	6.43	5.19	5.52	6.61	7.25
S. D.	2.90	2.48	2.65	2.39	2.86	2.50	2.37	1.79

Possible Correct = 8

Since rote counting is not a skill emphasized in the SMSG kindergarten curriculum, it is not surprising that there is little change in several of the class means over the year. For classes e, f, and g, as well as f' as shown in Table 75, the means are the same as at the beginning of the year (Table 25). Classes c and d, as well as g', showed higher means at the end of the year than at the beginning.

For the first grades, Table 76, an increase in means from the Initial Inventory (Table 25) is seen in every class. With these increases in class means, there is an attendant increase in sigmas for all of the experimental classes. That is, while many of the children in the experimental classes can now count to 40 or 50, although they could count no higher than 20 at the beginning of the school year, others are able to count correctly no higher than nine at the end of the year. The sigmas for the two comparison classes, G' and H', have become smaller, however, with the increase in means.

TABLE 77

DIFFERENCES BETWEEN SAMPLE MEANS ON ROTE COUNTING: Final Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	2.812		2.810	148, 27	0.005	n.s.
	2.812	2.390		148, 23	0.968	n.s.
		2.390	2.810	23, 27	0.757	n.s.
First Grade	5.083		7.250	155, 24	-3.879	.001
	5.083	6.610		155, 28	-2.854	.01
		6.610	7.250	28, 24	1.063	n.s.

Table 77 shows that there are no significant differences between the means of the samples at the end of the kindergarten year on Rote Counting. There are differences between the first grade sample means, with the experimental sample performing significantly less well than either the socio-economic $(p < .01)$ or curriculum comparison $(p < .001)$ class. The same pattern was observed on the Initial Inventory results (Table 26), with no differences found between the kindergarten sample means but significantly higher means obtained by both the socio-economic and comparison groups than by the experimental group at first grade.

In interpreting the differences between the first grade samples on the Final Inventory, it must be emphasized that the teachers of the experimental classes were concerned about the children learning to count objects as part of their work with sets. They may have minimized rote counting either because they thought it antithetical to the curriculum or because of insufficient time to devote to both. For the curriculum comparison class, counting by ones, twos, fives, and tens is a skill to be developed in the first grade as part of the understanding of numbers and operations, and it is evident from these findings that they are learning to count by ones, at least.

d. Rote Counting by Tens

Counting by tens was tested only on the Final Inventory and included only for the first grade children. As with rote counting by ones, the child was simply asked to count by tens. Children who were able to continue counting up to 200 were stopped at that point. Thus, the scoring, as can be observed in Table 78, is based on twenty as the highest possible score.

TABLE 78

ROTE COUNTING - BY TENS:
Final Inventory

Kindergarten	Experimental Classes						Comparison Classes	
							Socio-Economic	Curriculum
	C	D	E	F	G	H	G'	H'
N of Pupils	25	24	26	30	24	23	27	24
Range: Correct Responses	1-10	0-20	0-10	5.20	2-9	7-10	1-19	9-20
Mean	8.80	9.46	9.54	10.27	7.42	9.74	13.33	18.17
S. D.	2.67	2.94	1.93	3.38	2.20	0.67	6.33	3.67

Possible Correct = 20

The above table indicates a considerable discrepancy in performance on this task between the experimental and comparison classes. Although there is some variability from one experimental class to another, not even Class F, with the highest mean, approaches the mean of either of the two comparison classes. The standard deviations for the experimental classes are smaller than are those for the comparison classes despite the range of correct responses extending from 0 to 20 in Class D.

TABLE 79

DIFFERENCES BETWEEN SAMPLE MEANS ON ROTE COUNTING BY TENS: Final Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
First Grade	9.245		18.170	152, 24	-14.795	.001
	9.245	13.330		152, 27	-5.718	.001
		13.330	18.170	27, 24	3.222	.01

Table 79 shows the extent of the differences between the sample means on rote counting by tens. Whether this significantly poorer performance of the experimental first grade children is attributable to less emphasis on sheer practice of counting by tens, or whether these children have greater difficulty in learning a series of number names as a result of prior language development can not be ascertained at this time. The fact that the socio-economically more advantaged class, using the SMSG curriculum, has a significantly higher mean score suggests either teacher differences or differences in the rate of pupil learning. It is probable that the number names are more familiar to the more advantaged children and that there is reinforcement for their learning outside the classroom. The level of performance of the curriculum comparison class indicates clearly their learning of the curriculum employed.

These findings on rote counting by tens are consistent with those found on rote counting by ones presented in the previous section. Whether disadvantaged children need more time to learn these rote counting tasks than do more advantaged children and whether rote learning of number names is related to the understanding of such concepts as place value are still open questions.

e. Number Symbols

The various parts of the number symbol assessment were, for the kindergarten children, retests of those given on the Initial Inventory. For the first grade children, all three parts of Number Symbols were extensions of the Initial Inventory task.[25]

The reasons for repeating the Initial tests of number symbols for the kindergarten children were that few of them were able to recognize or form numerals at the beginning of the school year. In addition, the SMSG kindergarten program does not emphasize writing of numerals or recognition beyond that tested in the Initial Inventory. For the first grades, it could not be expected that the children would be able to handle numerals up to 100 at the beginning of the school year, but since these are included in the first grade program, assessing learning of them at the end of the school year is reasonable.

Table 80 gives the kindergarten class means for both identifying and marking of Number Symbols. It is apparent from the means on the two parts of this test that identifying numerals presented is an easier task for the kindergarten children than is writing numerals. There are still children in every class who cannot write any one of the numerals presented as seen in the range of correct responses to marking.

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25. For the testing procedure and results of Number Symbols on the Initial Inventory, see pages 31-34. For the test instructions and numerals tested on the Final Inventory, see Appendix C, pages 118-122.

TABLE 80

NUMBER SYMBOLS: Final Inventory

	Kindergarten	Experimental Classes					Comparison	
							Socio-Econ.	Curriculum
		c	d	e	f	g	f'	g'
	N of Pupils	44	27	28	25	27	23	27
IDENTIFYING	Range: Correct Responses	1-8	1-8	0-8	0-8	4-8	0-8	1-8
	Mean	6.64	6.81	5.18	6.92	6.67	7.43	6.04
Possible Correct =8	S. D.	1.87	1.66	3.16	2.08	1.25	1.88	2.28
MARKING	Range: Correct Responses	0-7	0-7	0-7	0-6	0-7	0-7	0-7
	Mean	2.91	3.22	2.89	2.40	4.44	4.22	3.04
Possible Correct =7	S. D.	2.05	2.47	2.77	1.96	1.91	2.52	2.47

Progress over the school year in these facets of learning about numerals can be seen by comparing Table 80 with Tables 27 and 30. The class means on Identifying on the Initial Inventory ranged between 0.93 and 3.56 for the experimental classes, while the socio-economic comparison classes were 5.50 and 5.09 and the curriculum comparison 3.30. The means across all classes on the Final Inventory now range from 5.18 for Class e to 7.43 for Class f'.

On Marking, the progress is from kindergarten class means of less than 1.0 in most classes to means ranging from 2.40 to 4.44.

TABLE 81

DIFFERENCES BETWEEN SAMPLE MEANS ON NUMBER SYMBOLS: Final Inventory

Kindergarten	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
IDENTIFYING	6.451		6.040	151, 27	0.933	n.s.
	6.451	7.430		151, 23	-2.132	n.s.(.05)
		7.430	6.040	23, 27	-2.280	n.s.(.05)
MARKING	3.151		3.040	151, 27	0.234	n.s.
	3.151	4.220		151, 23	-2.100	n.s.(.05)
		4.220	3.040	23, 27	-1.634	n.s.

The differences between means of the kindergarten groups presented in Table 81 show no differences reaching the accepted .01 level of significance, although on both Identifying and Marking, there are differences between the experimental and socio-economic comparison groups which attain the .05 level. In both instances, these differences show the more advantaged children to be performing better. When these differences are viewed within the context of change over the school year, however, it must be pointed out that the differences between these samples on Identifying Number Symbols were significant at the .001 level on the Initial Inventory. The difference between the disadvantaged and more advantaged kindergarten children on Marking was not significant on the Initial Inventory. Thus, although the experimental children are not performing quite as well on these tests of Number Symbols at the end of the kindergarten year as are the socio-economically more advantaged children, the gap in Identifying Number Symbols has been narrowed considerably. In addition, the disadvantaged children continue to perform at the same level as the curriculum comparison class.

For the first grade classes, in addition to the Identifying or recognizing of numerals and writing numerals, the children were also requested to name numerals printed on cards. Table 82 presents the results for the first grade classes on all three parts of the Number Symbol assessment.

TABLE 82

NUMBER SYMBOLS: Final Inventory

		Experimental Classes						Comparison	
	First Grade							Socio-Econ.	Curriculum
		C	D	E	F	G	H	G'	H'
	N of Pupils	25	24	25	28	25	19	24	24
IDENTIFYING	Range: Correct Responses	0-10	0-10	3-10	0-10	3-10	0-10	5-10	0-10
	Mean	8.80	8.50	8.44	9.50	9.20	8.16	9.75	9.54
Possible Correct = 10	S. D.	2.48	3.08	2.10	1.90	1.81	2.62	1.01	2.00
NAMING	Range: Correct Responses	1-12	1-12	2-12	0-12	0-12	0-12	6-12	0-12
	Mean	8.44	8.63	8.28	10.00	7.60	8.95	11.58	11.21
Possible Correct = 12	S. D.	3.83	3.76	4.02	3.79	4.65	3.49	1.26	2.57
MARKING	Range: Correct Responses	0-9	0-9	0-9	0-9	0-9	0-9	2-9	4-9
	Mean	5.44	5.38	4.24	7.00	5.48	5.32	8.08	8.33
Possible Correct = 9	S. D.	2.95	2.84	3.17	2.89	2.91	3.20	1.78	1.46

The experimental classes' performance on Identifying is better than on the other two parts of the Number Symbols test when the range of class means is looked at in terms of the number of items (Possible Correct) for each portion of the test. The wide variability within the experimental classes is apparent for all three parts of this assessment as evidenced by the large standard deviations. The most difficult task of the three for the disadvantaged children at this point in time appears to be Marking, i.e., writing numerals.

In addition to the wide variability within experimental classes, there is considerable variability between them. The performance of Class F is superior on all three portions of Number Symbols to that of the other experimental classes. Yet, the mean of Class F is not as high as either of the comparison classes on any portion of this assessment.

TABLE 83

DIFFERENCES BETWEEN SAMPLE MEANS ON
NUMBER SYMBOLS: Final Inventory

First Grade	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
IDENTIFYING	8.808		9.540	146, 24	-1.448	n.s.
	8.808	9.750		146, 24	-1.944	n.s.
		9.750	9.540	24, 24	-0.449	n.s.
NAMING	8.666		11.210	146, 24	-3.021	.01
	8.666	11.580		146, 24	-3.548	.001
		11.580	11.210	24, 24	-0.620	n.s.
MARKING	5.515		8.330	146, 24	-4.514	.001
	5.515	8.080		146, 24	-4.075	.001
		8.080	8.330	24, 24	0.521	n.s.

The differences between means presented in Table 83 show the experimental sample's performance on Identifying to be statistically no different from that of the comparison classes. This finding is striking in contrast to the results on the Initial Inventory for Identifying Number Symbols (Table 29), at which time the mean of the socio-economic comparison sample (7.948) and that of the curriculum comparison group (7.630) were both significantly higher ($p < .001$) than that of the experimental sample (5.538). Thus, the gap in performance between the disadvantaged and more advantaged children has been narrowed over the year on this particular facet of number knowledge.

On the Marking portion of Number Symbols, the sample means in Table 83 are significantly different, with the experimental first grade sample performing less well than either of the two comparison classes. Differences at this same level of confidence and in the same direction were also found on the Initial Inventory. This suggests that these children may need considerably more help in writing numerals, and probably, also, help in the process of translating from the spoken word, e.g., "sixteen," to the written symbols representing it.

Since Naming is an aspect of Number Symbols not tested earlier in the school year, no judgment of progress can be made from the means on Naming, shown in Table 83; however, the poorer performance of the experimental first grade children is apparent. Their sample mean is significantly lower than that of both the curriculum comparison class $(p < .01)$ and the socio-economic comparison class $(p < .001)$. The difference between the experimental sample's performance on Identifying and on Naming of Number Symbols suggests that language deficiency may be involved in their relatively poorer performance on Naming.

f. Place Value

In order to develop the idea of place value, the first grade children were given considerable experience with sets of objects which were partitioned into sets of ten. They were taught the names for multiples of ten, and then the names for the numbers between ten and twenty.

To test these learnings, the children were given two tasks. The first was the naming of sets of objects composed of sets of tens and ones. For this, paste sticks, some of which were bundled into groups of ten and others kept singly, were used. The tester explained that each bundle contained ten paste sticks, and then placed a specified number of these in front of the child and asked how many sticks were there.[26]

The second task to assess place value was having the children form a specified set. The instructions were for the child to use the bundles of tens and the single sticks to make, for example, a set of sixteen sticks.

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[26] For the Place Value test instructions and materials used, see Appendix C, pp. 122-123.

The results of both the Naming and Forming are presented in Table 84. The variability in performance between experimental classes is very great.

TABLE 84

PLACE VALUE: Final Inventory

	First Grade	Experimental Classes						Comparison	
								Socio-Econ.	Curriculum
		C	D	E	F	G	H	G'	H'
NAMING	N of Pupils	25	24	25	28	25	19	24	24
	Range: Correct Responses	0-10	0-10	0-10	4-10	0-10	4-10	1-10	4-10
Possible Correct = 10	Mean	3.96	6.79	7.76	9.25	6.32	8.95	8.25	8.54
	S. D.	3.87	2.81	3.13	1.62	3.07	1.76	2.98	2.22
FORMING	N of Pupils	25	24	25	28	25	19	24	24
	Range: Correct Responses	0-9	0-9	1-9	0-9	0-9	2-9	1-9	0-9
Possible Correct = 9	Mean	3.12	4.00	5.84	7.61	3.80	5.74	7.88	6.96
	S. D.	3.28	2.97	2.48	2.60	2.79	2.81	2.32	3.05

Class F, with a mean of 9.25 on Naming and Class H with a mean of 8.95, performed better than any of the other experimental classes and better than either of the two comparison classes, as well; while Class C, with a mean of 3.96, is far below the performance of any of the other classes. A similar trend is seen on the Forming portion, with the same experimental classes having the highest and lowest means, although on Forming, the mean of Class F (7.61) is slightly lower than that of Class G' (7.88).

The variability in performance within classes on Naming is also extremely diverse when comparing one class to another. In addition, it is interesting to note that Naming is evidently an easier task for these first grade classes than is Forming of sets utilizing tens and ones.

TABLE 85

DIFFERENCES BETWEEN SAMPLE MEANS ON PLACE VALUE: Final Inventory

First Grade	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
NAMING	7.144		8.540	146, 24	-2.278	n.s. (.05)
	7.144	8.250		146, 24	-1.743	n.s.
		8.250	8.540	24, 24	0.374	n.s.
FORMING	5.049		6.960	146, 24	-3.020	.01
	5.049	7.880		146, 24	-4.633	.001
		7.880	6.960	24, 24	-1.151	n.s.

The differences between sample means presented in Table 85 show the experimental sample's performance to be almost the same as that of the two comparison classes on Naming, the only directional (.05) difference being that between the experimental and curriculum comparison class, a difference not achieving the accepted level of .01. On Forming, however, the differences are very clear with the experimental sample performing significantly less well than either comparison group.

The interpretation of these findings will be prefaced by two qualifications. First, the progress of the disadvantaged classes tended to be slower than that of the more advantaged. If the disadvantaged children progressed at about the same pace, it was because the teacher was devoting almost twice as much time to mathematics as was the teacher of the more advantaged children. The second consideration is that the concept of place value is a difficult one for most first grade children, an evaluation made by teachers of very advantaged children as well as by teachers of less advantaged children.

That the disadvantaged children can learn the names for sets of tens and ones about as well as the other groups by the end of first grade is reassuring. That they perform significantly less well on Forming of such sets than do the two comparison groups suggests either that Forming such sets is more difficult than Naming, or that they have had less practice with Forming. If one considers what is involved for the child in having to form a set of twenty-seven, for example, it would seem that the explanation of this as being a more difficult task is a reasonable one. The child must "hold in his mind" the number twenty-seven while he counts out sets of tens and ones from a larger collection of such sets. This interpretation may be related to the findings on Visual Memory, Pictures, (Table 62, page 59) which showed that the experimental first grade children performed better on immediate recall of pictures than did the experimental kindergartens, a finding reversed for the two comparison groups. It was suggested that visual memory of a longer, more delayed nature might be observed more frequently as immediate imagery drops out. If "holding in mind" a number in order to form the appropriate set implies a mental image of the numeral, then this interpretation is relevant to Forming on the Place Value assessment.

The other set of findings presented earlier which need to be related to Place Value are those on Rote Counting by Tens (pp. 74-75). The experimental first grade sample performed significantly less well on this latter assessment than did the two comparison classes, but they performed about as well on Naming of sets of tens and ones. This suggests that the rote task of counting by tens has little relationship to the naming of sets which involve number names for sets of tens. To test this, however, intercorrelations between these tasks need to be done.

g. Ordinal Number

To measure the children's understanding of ordinal number, five plastic toy trucks were lined up on the table, and the child was asked to place a marble in the first truck, the fourth truck, and so on.[27] The child was permitted to determine his own reference for the order of first through fifth since the test began by asking the child to put the marble in the first truck. Scoring then depended upon the child's placing the marbles according to his own determination of first in the series. The first nine items required the child to place marbles in specified trucks; the last nine required him to remove them from requested trucks.

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27. For the Ordinal Number test instructions and materials, see Appendix C, pp. 124-125.

TABLE 86

ORDINAL NUMBER: Final Inventory

Kindergarten	Experimental Classes					Comparison Classes	
						Socio-Economic	Curriculum
	c	d	e	f	g	f'	g'
N of Pupils	44	27	26	25	27	23	27
Range: Correct Responses	3-18	4-18	0-18	5-18	0-18	0-18	1-18
Mean	9.14	11.78	10.19	11.60	13.07	12.44	12.04
S. D.	5.32	5.09	7.39	4.59	4.72	5.63	4.76

Possible Correct = 18

Table 86 presents the class means for the kindergarten classes, and Table 87 presents comparable findings for the first grades.

TABLE 87

ORDINAL NUMBER: Final Inventory

First Grade	Experimental Classes						Comparison Classes	
							Socio-Economic	Curriculum
	C	D	E	F	G	H	G'	H'
N of Pupils	25	24	26	30	26	23	28	24
Range: Correct Responses	4-18	3-18	3-18	5-18	3-18	0-18	9-18	4-18
Mean	11.84	11.42	15.65	15.93	14.00	14.44	16.46	16.83
S. D.	4.90	4.59	3.96	3.78	4.80	4.70	2.54	3.13

Possible Correct = 18

The means of the experimental kindergarten classes (Table 86) show less inter-class variability than has been observed on some of the other end-of-year tests. Although there are still children in classes e and g who can do none of the Ordinal Number items correctly, this is no different from class f'. In the other three experimental classes, all of the children are able to do a minimum of three correctly. It should also be noted that the means of the best performing experimental kindergarten classes (g, d, and f) are higher than the poorest performing experimental first grade (Table 87, Class D). It may be that the children in Class D are less capable than the children in the better-performing kindergartens; a more likely explanation is that special intervention at an earlier chronological age but with sufficient readiness to learn produces greater effects on performance. This interpretation seems to be supported by the findings shown in Table 88.

TABLE 88

DIFFERENCES BETWEEN SAMPLE MEANS ON ORDINAL NUMBER: Final Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	11.100		12.780	151, 27	-1,476	n.s.
	11.100	12.430		151, 23	-1.056	n.s.
		12.430	12.780	23, 27	0.243	n.s.
First Grade	14.110		16.830	154, 24	-2.588	.01
	14.110	16.470		154, 28	-2.418	n.s.(.02)
		16.470	16.830	28, 24	0.457	n.s.

The experimental kindergarten sample mean is statistically no different from the two comparison classes. The experimental first grade sample mean is, on the other hand, significantly lower ($p < .01$) than that of the curriculum comparison class and approaches significance ($p < .02$) when compared with the more advantaged class. Whether the performance of the disadvantaged kindergarten children will be similar to that of children with what is assumed to be more experiental readiness demands a follow-up of the children started in the program at kindergarten.

5. Ordering and Classifying

Ordering and classifying were assessed on the Midyear Inventory.[28] The test given on the Final Inventory[29] was an alternate form of the seven items given on the Midyear Inventory plus four additional items, each of which required both ordering and classifying.

As with the midyear findings, the results on this test have been grouped across classes for the total eleven items as can be seen in Table 89.

TABLE 89

ORDERING AND CLASSIFYING: Final Inventory

		Experimental	Comparison Classes	
			Socio-Economic	Curriculum
Kindergarten	N of Pupils	148	23	26
	Range	0-11	1-11	3-11
	Mean	8.11	7.48	8.46
	S. D.	2.38	2.77	2.12
First Grade	N of Pupils	158	27	24
	Range	1-11	6-11	5-10
	Mean	7.90	8.33	8.40
	S. D.	2.12	1.22	1.29

Possible Correct = 11

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[28] For the testing procedure and results of Ordering and Classifying on the Midyear Inventory, see pp. 51-53.

[29] See Appendix C, pp. 126-128, for instructions and materials on Ordering and Classifying, Final Inventory.

From the means and standard deviations shown, the experimental first grade sample appears to perform less well in relation to the two comparison first grade classes than does the experimental kindergarten sample. Although the differences between the disadvantaged first grade sample and the two comparison classes are not significant, as can be observed in Table 90, the means of the experimental first grade group is slightly lower than that of the experimental kindergarten sample and the standard deviations are very similar (Table 89). Again, these findings suggest the greater gains that may accrue from intervention at kindergarten rather than waiting until first grade.

TABLE 90

DIFFERENCES BETWEEN SAMPLE MEANS ON ORDERING AND CLASSIFYING: Final Inventory

	Sample Means			N	t	Significance Level
	Exper.	Socio-Econ. Comp.	Curric. Comp.			
Kindergarten	8.110		8.460	148, 26	-0.698	n.s.
	8.110	7.480		148, 23	1.147	n.s.
		7.480	8.460	23, 26	1.370	n.s.
First Grade	7.900		8.400	158, 24	-1.118	n.s.
	7.900	8.330		158, 27	-1.020	n.s.
		8.330	8.400	27, 24	0.195	n.s.

If this test is a valid measure of conceptual development, then the experimental children do not appear as disadvantaged as anticipated. It is recognized, however, that this particular test and the facets of conceptual development which it attempted to measure, i.e., ordering and classifying, may not be sufficient indices of concept development. It is recognized further, that differences of considerable magnitude were found on aspects of number concepts which are not likely to be unrelated to concept development conceived more broadly. This last interpretation needs to be verified empirically.

IX SUMMARY AND IMPLICATIONS

The results presented in this report were obtained from a pilot project undertaken to evaluate the learning by children, defined as culturally disadvantaged, of SMSG elementary materials. Six kindergarten and seven first grade classes in disadvantaged areas of six cities were tested at the beginning of the 1964-65 school year. In addition, two classes at each of these grade levels but from higher socio-economic areas were tested as was one kindergarten and one first grade class using a curriculum other than SMSG. Most of these classes were followed throughout the school year with individual tests being administered at the middle and end of the year as well as at the beginning. Classroom observations, teacher reports, and a group test administered at the end of the school year provided other kinds of data.

The present report has dealt with the individual test results only. Apart from the substantive findings on these tests, certain trends deserve mention. The variability in performance within the disadvantaged classes was shown to be consistently very large. The variability between classes of disadvantaged children was also found with regularity. Both of these trends demand a more careful look at the factors affecting the individual's performance and make imperative a caution in grouping the findings of a number of classes on the basis that they are all composed of children who can be described as disadvantaged.

The changes in performance of the disadvantaged kindergarten children over the year were, on many of the tests, different from those changes observed in the first grade children. At this stage of the analysis, those changes which are effects of the differences in curriculum content at the two levels cannot be partialled out from those which may be attributed to the effects of earlier intervention with a structured mathematics program at the kindergarten grade.

One limitation in interpreting differences in the performance of the disadvantaged experimental classes from the performance of the socio-economically more advantaged and curriculum comparison classes is inherent in the size and the composition of the two comparison groups. Although the statistical differences were treated conservatively, the comparison groups were small, and the curriculum comparison classes varied from the experimental classes on demographic indices as well as on the curriculum used.

The need for additional analyses of the data collected in this study is clear. Intercorrelations among the various tests will be studied as will the relationships between performance on the individual tests and on the group test. An analysis of the kinds of errors the children made, particularly in the number concept measures, may provide important insights into the process of learning mathematical ideas.

A further research need is for a longitudinal study to better evaluate the significance of providing experiences in mathematics at the kindergarten level on children's continued progress in the intermediate grades, a time at which the disadvantaged child's cumulative deficit has, in the past, become so apparent.

Appendix A

Report of the School Mathematics Study Group
Ad Hoc Committee on Below Average Achievers in Mathematics

An ad hoc committee met in Chicago on May 23, 1964 to review the recommendations of the April Converence on Below Average Achievers in Mathematics. Those attending were: Florence Elder, Wade Ellis, Kirk Fort, Lenore John, Irene Sauble, and J. F. Weaver. SMSG Headquarters was represented by E. G. Begle, M. E. Dunkley, and Gloria Leiderman.

The committee was asked to recommend specific projects for SMSG to undertake in the immediate future. The committee recommended that experimental materials be prepared in the summer of 1965 of the following kinds:

1. At the kindergarten and first grade level: Materials for teachers emphasizing techniques for providing disadvantaged children with the experiences necessary for the formation of the fundamental concepts of arithmetic.
2. For the grades from 3 or 4 to 7 or 8: Materials for students in which the conceptual aspects of mathematics are sharply separated from the computational, with the expectation that the rates at which a student will progress in the two areas will be quite independent.
3. For seventh grade (and perhaps fourth grade) students: Material which reviews from a different point of view the mathematics previously studied. New materials prepared for earlier grades may be written with illustrations and problems appropriate to the seventh (fourth) grade.
4. For junior high school students (and perhaps others): Materials which relieve the students from the burden of computation as much as possible, by providing slide rules, books of tables, pocket computers, etc.
5. For students in technical vocational programs: Sets of texts, all with the same core of mathematics but with the illustrations and problems in each text relevant to a particular vocation.

In order to prepare for the summer of 1965, the committee recommends:

A. The establishment, in appropriate schools, of "observation points" which will help to provide some of the information needed for the first project above.

B. A study, perhaps by means of one or more conferences, of the mathematics programs for the training of technicians.

The committee also recommends close liaison and cooperation with other groups with similar interests.

Appendix B

Background Information Form

(Front)

Name ______________________________ Birthdate ______________
(first) (last)

Lives with (check) ☐ Mother ☐ Father ☐ Both Parents ☐ Other ______________ (give relationship)

Occupation of Parent/Guardian ______________

Education of Parent/Guardian ______________

If lives with both parents, does mother work? Yes____ No____

Siblings

Name	Sex	Age

Date Enrolled ______________

Previous School (if any) ______________

Previous School Experience (check)

	Length of Attendance
☐ Day Care	______________
☐ Nursery	______________
☐ Kindergarten	______________
☐ First Grade	______________

(Back)

Attendance Record

Days Absent	Total No. of School Days	
		First Semester (until Jan 29)
		Second Semester (until ____)

Standardized Test Scores (if available)

Name of Test	Form	Results
______________	______________	______________
______________	______________	______________

Health problems and other factors that may influence school performance ____

____

____

APPENDIX C

Individual Inventories

GENERAL DIRECTIONS

I SETTING FOR ADMINISTRATION OF TESTS

It is important to have a separate room, if at all possible, so that interruptions and distractions are minimized.

In introducing these tests to the child, make certain that they are always referred to as games and not as tests. The child will feel more comfortable if this is not presented as a testing situation and if the tester chats with the child to put him at ease before starting.

II EQUIPMENT

You will need a table and two chairs. Preferably, the table and chairs should be low (from the kindergarten or first-grade classroom) so that they are a comfortable height for the child. Seat the child across the table from you.

The materials you will need are those supplied and include:

1	set geometric shapes
50	buttons
4	boxes with tops
	pads of paper
	crayons
1	set of 8 number cards for counting members
10	envelopes with buttons inside and numerals on them
1	set of 6 number cards for equivalent sets
	objects for visual memory (1 each): apple, banana, book, box, button, car, cat, chair, clock, cork, cow, crayon, dog, horse, money, orange, pencil, rubberbands, and string
12	blocks
2	sheets of construction paper
5	trucks
25	marbles
7	sets for ordering and classifying
5	sets of pictures for visual memory
1	set of color cards

III PROCEDURE

Read over the instructions for administering the tests several times, and become familiar with the materials before you start testing your children.

The instructions for you, as tester, are typed in lower case. What you actually say to the child is typed in capital letters.

Follow the written directions carefully. Do not probe to get an answer beyond what is suggested in the directions--this is an evaluation and should not be used as a teaching situation.

Use reassurance without specifying that responses are right or wrong. This may be done in a variety of ways:

Repeating what the child has said in a reassuring voice.
Remarks such as "Um - Hum", "All Right".
Comments between tests such as "You do these very well".
Conversation with the child between tests.

In order that the child not experience failure, certain tests are not to be continued if the child fails 2 consecutive tasks in that part of the test. This will be noted in the instructions for the specific tests. On tests, such as ordering, you will continue the entire test whether the child misses two consecutive tasks or not.

Keep all equipment in a box under the table to your right. Place on the table only those items required for a given task, along with the instructions and score sheets for that particular task. Remove materials used for a task from the table before beginning the next part of the testing.

IV SCORING

The scoring sheets should be completely filled out.

Be certain to enter the child's name on each scoring sheet. It is important to use the "Comments" space whenever relevant. These comments will be helpful in two ways.

(1) In following the progress of each child;
(2) In revising the tests.

In certain of the tasks, specific comments are requested (e.g., Ordering). Be certain to enter comments where specifically noted and at any points where they are relevant to understanding the child's response. If doubtful about the correctness of a response, do not check the response as correct or incorrect, but write down exactly what the child said in the "Comments" space.

V IMPORTANT CONSIDERATIONS

In order for these test results to be meaningful:

(1) it is imperative that the tester adhere to the written directions as closely as possible. Rapport with the child is crucial; however, cueing the child beyond the written directions invalidates the results.

(2) it is imperative that recording of children's performance on the score sheet be as accurate as possible. Score sheets may be completed in pencil; overemphasis on neatness may be unnecessarily time-consuming. Entries should be legible and accurate; neatness is not a primary consideration.

(3) it is imperative that every subtest be completely recorded.

(4) it is imperative that the testing be scheduled so that you will finish testing the children assigned to you within the next few weeks.

SPECIFIC DIRECTIONS

I VISUAL RECOGNITION (Kindergarten and First Grade)

A. Object Recognition

1. Materials

Assorted toys: truck, chair, button, penny, orange, dog, box, car, nickel, pencil, key, apple, cat, clock, rubber bands, book, dime, banana, horse, string, crayon, cow, cork.

2. Directions

I AM GOING TO SHOW YOU SOME THINGS. YOU TELL ME THE NAMES OF THE THINGS I SHOW YOU.

Show ______________. (Show objects in order listed on the scoring sheets.)

WHAT IS THIS?

If child gives the incorrect name or more generic name, e.g., animal for horse, say:

WHAT ELSE COULD IT BE?

If still not the specific name, say:

IS IT LIKE SOMETHING ELSE YOU KNOW?

If still not correct name, say:

DO YOU KNOW WHAT IT IS USED FOR?

Present objects in the order listed on the scoring sheet.

3. Scoring System

Object Recognition

Object	Correct (✓)	Incorrect (✓)	Comment
Truck			
Chair			
Button			
Penny			
Orange			
Dog			
Box			
Car			
Nickel			
Pencil			
Key			
Apple			
Cat			
Clock			
Rubber Bands			
Book			
Dime			
Banana			
Horse			
String			
Crayon			
Cow			
Cork			

B. Photograph Recognition

1. Materials

   Photographs of truck, money, banana, dog, buttons, clock, car, cat, book, apple.

2. Directions

   LET'S TRY ANOTHER GAME LIKE THIS. I AM GOING TO SHOW YOU PICTURES OF SOME THINGS. YOU TELL ME WHAT THEY ARE.

   Show ____________. (Show photographs in order listed on the scoring sheet.)

   WHAT IS THIS?

   If child gives the incorrect name or more generic name, e.g., animal for horse, say:

   WHAT ELSE COULD IT BE?

   If still not the correct name, say:

   IS IT LIKE SOMETHING ELSE YOU KNOW?

   Present photographs in the order listed on the scoring sheet.

3. Scoring System

Photograph Recognition

	Correct (✓)	Incorrect (✓)	Comment
Truck			
Money			
Banana			
Dog			
Buttons			
Clock			
Car			
Cat			
Book			
Apple			

C. Recognition of Drawings

1. Materials

   Drawing of book, cat, dog, apple, money, car, clock.

2. Directions

   THIS TIME I'M GOING TO SHOW YOU SOME DRAWINGS. YOU TELL ME WHAT THEY ARE.

   Show ______________. (Show drawings in order listed on the scoring sheet.

   WHAT IS THIS?

   If child gives the incorrect name, say:

   WHAT ELSE COULD IT BE?

   If still not the specific name, say:

   IS IT LIKE SOMETHING ELSE YOU KNOW?

   Present drawings in the order listed on the scoring sheet.

3. Scoring System

Drawing Recognition

	Correct (✓)	Incorrect (✓)	Comment
Book			
Cat			
Dog			
Apple			
Money			
Car			
Clock			

II VOCABULARY (Kindergarten and First Grade)

1. Materials

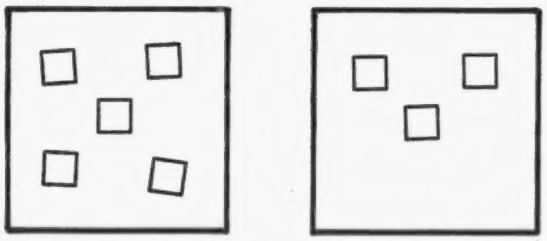
   12 blocks, 2 sheets of construction paper.

2. Directions

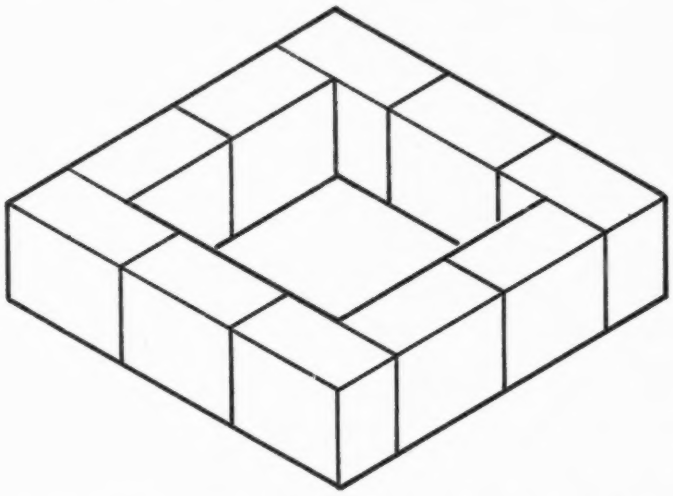
   Keep blocks in box on floor to experimenter's left.
   If blocks are needed on the table, keep them piled to your right.
   Build all sets which you must construct to your right. When not in use, remove blocks from the table.

Vocabulary	Materials	Directions
a. Behind	1 block	Hand child 1 block. CAN YOU PUT THIS BLOCK BEHIND YOU? If child does not respond, say: CAN YOU PUT THE BLOCK BEHIND YOUR BACK SO THAT I CAN'T SEE IT?
b. Above		NOW HOLD THE BLOCK ABOVE YOU. If child does not respond, say: CAN YOU HOLD THAT BLOCK ABOVE YOUR HEAD?
c. On	Sheet of construction paper	Place sheet of paper on table between you and child. I WANT YOU TO PUT SOME BLOCKS ON THE PAPER FOR ME. Hand child 3 blocks. If child does not put the blocks on the paper, say: PUT THE BLOCKS ON THE PAPER. If child still does not put the blocks on the paper, score as 'not attempted' and then place the blocks on the paper.

Vocabulary	Materials	Directions
d. Between	12 blocks Sheet of construction paper	Hand child 4 blocks. WILL YOU BUILD A TOWER ON THE PAPER WITH THESE BLOCKS? If child does not start, say: STACK THEM UP LIKE THIS. (And start stacking blocks. Stack 2 and tell child:) YOU GO AHEAD AND PUT THE BLOCKS ON THE TOWER. If child has difficulty, don't push him; help him build the tower. When tower is built, say: NOW I AM GOING TO BUILD 2 MORE TOWERS. Build 2 more 4-block towers in a row on the paper next to the child's tower with a 3-inch separation between each 2. WHICH IS THE TOWER BETWEEN THE OTHERS?
e. Each		CAN YOU TOUCH EACH TOWER?
f. Remove		ALL RIGHT, NOW I WANT YOU TO REMOVE THE BLOCKS FROM THE PAPER.
g. Set	Sheet of construction paper Object: blocks, pencils	Put all blocks in a heap at the side of the table to your right. Have your pen or pencil and papers on the table. Place the sheet of construction paper in front of the child. NOW, I WANT YOU TO MAKE A SET HERE ON THE PAPER. Point to the construction paper. Any collection of objects-blocks, pencils, etc., placed on the paper is acceptable. If child does not respond, say: PUT A SET OF THESE OBJECTS (pointing to objects) ON THIS PAPER (pointing to sheet of paper).

Vocabulary	Materials	Directions
h. More than	2 sheets of construction paper	Place two pieces of construction paper, with 3 inches between the two sheets, in front of the child. HERE ARE 2 SHEETS OF PAPER. I AM GOING TO PUT SOME BLOCKS ON THIS SHEET OF PAPER. Place 3 blocks on sheet to your right. YOU PUT MORE BLOCKS ON YOUR PAPER (pointing to empty sheet) THAN I PUT ON THIS (pointing to your sheet). If child cannot do this task, place 5 blocks on empty paper, say: NOW, WHICH PAPER HAS MORE BLOCKS ON IT THAN THE OTHER PAPER?  If child does not respond, say: WHICH OF THESE PAPERS (pointing to the 2 sheets) HAS MORE BLOCKS ON IT?
i. As many as	2 sheets of construction paper 12 blocks	Leave the 2 pieces of paper in front of the child. Have blocks heaped at the side of the table. Place 4 blocks on paper to your right. I AM PUTTING SOME BLOCKS ON THIS PAPER. YOU PUT AS MANY BLOCKS ON THIS PAPER (pointing to empty sheet) AS I HAVE PUT ON THIS PAPER (pointing to sheet with blocks on it).

Vocabulary	Materials	Directions
j. Fewer than	2 sheets of construction paper 12 blocks	Leave the 2 sheets of paper in front of the child. Have all the blocks heaped at the side of the table. Place 5 blocks on the paper to your right. I HAVE A SET OF BLOCKS ON THIS PAPER (pointing to the paper with blocks). YOU PUT A SET WITH FEWER BLOCKS THAN THIS (again pointing to paper with blocks) HERE (pointing to empty sheet). If child does not respond, say: PUT FEWER BLOCKS ON THIS PAPER THAN I HAVE PUT ON THIS PAPER. If child still cannot do the task, score as 'not attempted' and place 3 blocks on the empty sheet.
k. Join		NOW, JOIN THESE TWO SETS OF BLOCKS. If child does not respond, say: CAN YOU JOIN THIS SET OF BLOCKS (pointing to blocks on paper to your left) TO THIS SET OF BLOCKS (pointing to blocks on paper to your right)? In scoring this item, comment whether child moved blocks from his left to right, his right to left, or both sets to the middle.
l. Below	1 block	Hand child 1 block. CAN YOU HOLD THAT BLOCK BELOW YOUR CHIN? If child does not respond, say: CAN YOU POINT TO YOUR CHIN? If child cannot correctly point to his chin, hold your hand, palm down, over the table at the height of the child's chin, and say: CAN YOU HOLD THE BLOCK BELOW MY HAND?

Vocabulary	Materials	Directions
m. Outside	12 blocks	Make a rectangular-shaped construction, using 10 blocks, in front of the child.  I AM BUILDING A WALL. CAN YOU PUT THIS BLOCK OUTSIDE THE WALL? (Hand the child 1 block.)
n. Inside		NOW, PUT THAT BLOCK INSIDE THE WALL.

3. Scoring System

No.	Word	Correct (✓)	Incorrect (✓)	Comment	No.	Word	Correct (✓)	Incorrect (✓)	Comment
1	Behind				9	As Many as			
2	Above				10	Fewer than			
3	On				11	Join			
4	Between				12	Below			
5	Each				13	Outside			
6	Remove				14	Inside			
7	Set				15	On			
8	More than								

III VISUAL MEMORY (Kindergarten and First Grade)

A. Objects

1. Materials

   Apple, banana, book, box, button, car, cat, chair, clock, cork, cow, crayon, dog, horse, money, orange, pencil, rubberbands, and string.

2. Directions

   NOW, WE WILL TRY A DIFFERENT GAME. I AM GOING TO PUT SOME THINGS ON THE TABLE. WATCH CAREFULLY.

   Place the objects in a line, from left to right, on the table as listed. First trial use Group 1, second trial Group 2, and so on.

   LOOK AT THEM VERY CAREFULLY.

   Make sure the child attends to the objects.

   I AM GOING TO TAKE ONE OF THESE AWAY (point to each object separately) WHILE YOU HAVE YOUR EYES CLOSED.
   NOW CLOSE YOUR EYES TIGHT AND KEEP THEM CLOSED UNTIL I TELL YOU TO OPEN THEM.

   Remove the underlined object from the table and place in box under table. Close objects up so that spacing is even.

   OPEN YOUR EYES. WHAT DID I TAKE AWAY?

   If the child is correct, mark under First Recall on score sheet and proceed with next group. If no reply, or incorrect, then say:

   WHAT ELSE WAS THERE BEFORE YOU CLOSED YOUR EYES THAT ISN'T THERE NOW?

   Pause. If correct, mark under Second Recall on score sheet and proceed with next group. If no reply, or incorrect, then say:

   DO YOU KNOW WHAT I TOOK AWAY?

   If child is correct this time, mark under Third Recall and proceed with next group. If child cannot recall, then proceed as follows:

   I'LL PUT SOME THINGS ON THE TABLE.

   Move objects already on the table to the side and put new set on the table in a line as listed. The object that was removed was underlined.

WHICH ONE OF THESE WAS ON THE TABLE BEFORE YOU CLOSED YOUR EYES?

If child cannot recognize the object included in the added set, tell and show him which object it was. Tell the child:

LET'S TRY ONE MORE GAME LIKE THIS.

3. Scoring System.

Visual Memory - Objects

	Original Group	Removed Object	First Recall	Second Recall	Third Recall	New Set	Correct Response	Incorrect Response
1	Orange Horse Rubber bands Car	Car				String Car Apple Cat		
2	String Banana Clock Box	Banana				Orange Dog Banana Rubber bands		
3	Apple Cow Pencil Book	Pencil				Cat Money Chair Pencil		
4	Cat Money Crayon Banana Chair	Cat				Clock Button Cork Cat		
5	Orange Dog Rubber bands Button Box	Rubber bands				Rubber bands String Horse Book		

B. Pictures

1. Materials

Set of five booklets with three pages of drawings in each.

2. Directions

HERE ARE PICTURES OF SOME THINGS YOU KNOW.

Place Practice Set in front of the child.

LOOK AT EACH OF THESE PICTURES VERY CAREFULLY.

Make sure the child attends to the pictures.

THE PICTURES ON THE NEXT PAGE ARE THE SAME, BUT ONE OF THESE (pointing to the pictures) WILL BE MISSING. YOU HAVE TO REMEMBER THE PICTURES ON THIS PAGE SO THAT YOU KNOW WHAT IS MISSING ON THE NEXT PAGE.

Make sure the child looks at both pictures. If child does not look at each picture, say:

LOOK AT EACH ONE.

Since the paper is thin and pictures can be seen through from the page underneath that being shown to the child, an unmarked sheet of paper is inserted between the one being shown and those underneath it. Fold back under the booklet both the page with the pictures shown and the unmarked sheet.

ALL RIGHT, WHAT PICTURE IS MISSING FROM THIS PAGE THAT WAS ON THE PAGE YOU JUST LOOKED AT?

If the child is correct, mark under First Recall on score sheet, and proceed with Set I. If the child does not reply, or is incorrect, say:

WHAT ELSE WAS ON THE LAST PAGE THAT ISN'T ON THIS PAGE?

Pause. If correct, mark under Second Recall on score sheet, and proceed with Set I. If no reply, or incorrect, then say:

DO YOU KNOW WHAT IS MISSING?

If the child is correct this time, mark under Third Recall, and proceed with Set I. If child still cannot recall, then proceed as follows:

I'LL SHOW YOU SOME NEW PICTURES.

Turn to the third page of the Practice Set, showing the mouse and the train. Say:

WHICH ONE OF THESE WAS ON THE FIRST PAGE BUT NOT ON THE PICTURE I JUST SHOWED YOU?

If child cannot recognize the removed picture in the new set, tell him and show him the train engine. Then, tell the child:

LET'S TRY ANOTHER GAME LIKE THIS.

Proceed with the same directions through Set IV.

In scoring this test, if the child makes a mistake in vocabulary, such as calling the bird a duck or the engine a train, this is acceptable. However, be sure to note this in Comments.

3. Scoring System

Visual Memory - Pictures

Original Set	Removed Picture	Recalls			New Set	Correct	Incorrect	Comments
		1st	2nd	3rd				
Pr Engine Fish	Engine				Mouse Engine			
1 Book Car Bird Apple	Bird				Kite Bird Crayons Fish			
2 Cat Boat Tree Crayons	Boat				Boat Book Bottle Turtle			
3 Truck Cup Rabbit Ball Umbrella	Ball				Engine Ball Tree Clock Cat			
4 Dog Bottle Hat Flower Clock	Dog				Cone Car Rabbit Umbrella Dog			

IV COLOR INVENTORY (Kindergarten and First Grade)

A. Matching Colors

1. Materials

Two sets of color cards.

2. Directions

I HAVE SOME COLOR CARDS. I AM GOING TO PUT THEM ON THE TABLE.

Arrange experimenter's color cards on table, from left to right: yellow, blue, brown, green, orange, red. Note that experimenter's set does not include black.

NOW I AM GOING TO PUT SOME ON THE TABLE FOR YOU, TOO.

Arrange pupil's cards on table with, from experimenter's left to right: orange, blue, red, black, brown, yellow, green. Pause for any spontaneous comments from pupil and record them in Other Observations.

Touch your green card but do not name the color.

LOOK AT THE COLOR CARD I AM TOUCHING. NOW LOOK AT ALL OF YOUR COLOR CARDS. DO YOU HAVE ONE JUST LIKE IT?

If child does not spontaneously point to his card, then say:

PUT YOUR FINGER ON THE COLOR CARD OF YOURS THAT IS JUST LIKE THIS ONE.

If pupil does not understand directions, or touches experimenter's card rather than his own, say:

PUT YOUR FINGER ON ONE OF THESE COLOR CARDS (pointing to his set) THAT IS JUST LIKE THIS ONE (THE ONE I AM TOUCHING).

Proceed in the order listed in the scoring sheets.

When Matching is completed, remove teacher's set of color cards from table, and start color Naming.

3. Scoring System

Matching Colors

Order of presentation	Color Card	Correct Response (✓)	Incorrect Response (✓)	No Response (✓)
1.	Green			
2.	Blue			
3.	Orange			
4.	Brown			
5.	Red			
6.	Yellow			

B. Naming Colors

1. Materials

One set of color cards.

2. Directions

Point in order to the color cards, starting with orange, and say:

CAN YOU TELL ME THE NAME OF THE COLORS?

WHAT COLOR IS THIS?

AND THIS ONE?

When Naming is complete, leave cards set up as they were for Naming, and start Identification of Colors.

3. Scoring System

Naming Colors

Order of presentation	Color Card	Correct Response (✓)	Incorrect Response (✓)	No Response (✓)
1.	Orange			
2.	Blue			
3.	Red			
4.	Black			
5.	Brown			
6.	Yellow			
7.	Green			

C. Identification of Colors

1. Materials

One set of color cards.

2. Directions

WOULD YOU GIVE ME THE RED CARD?

Proceed, using order listed on the scoring sheet.

3. Scoring System

Identification of Colors

Order of presentation	Color Card	Correct Response (✓)	Incorrect Response (✓)	No Response (✓)
1.	Red			
2.	Brown			
3.	Green			
4.	Orange			
5.	Yellow			
6.	Blue			

V GEOMETRIC SHAPES (Kindergarten and First Grade)

A. Matching

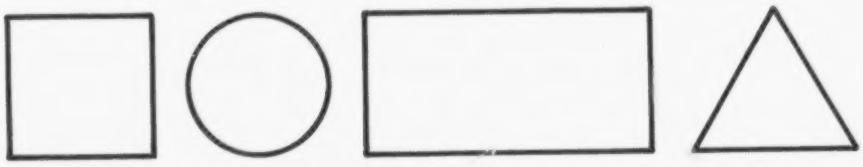
1. Materials

Two sets of geometric shapes.

2. Directions

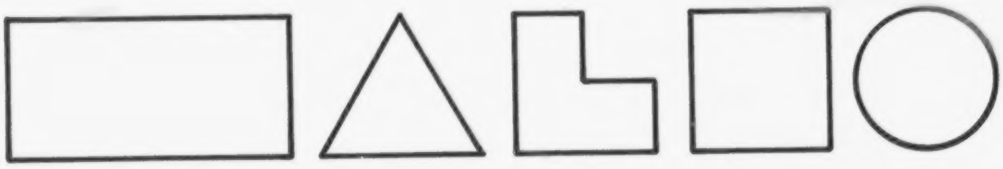
I HAVE SOME SHAPES HERE.
I AM GOING TO PUT THEM ON THE TABLE.

Place the set of shapes in front of you. Arrange from your left to right: square, circle, rectangle, triangle.



NOW I AM GOING TO PUT SOME ON THE TABLE FOR YOU, TOO.

Place the set of shapes, including the L-shaped region, from your left to right: rectangle, triangle, L-shape, square, circle.



Touch your circle but do not name it.

LOOK AT THE SHAPE I AM TOUCHING.
PUT YOUR FINGER ON THE SHAPE IN YOUR SET THAT IS JUST LIKE THIS ONE.

If child does not respond, or touches experimenter's shapes, say:

PUT YOUR FINGER ON ONE OF THESE SHAPES (pointing to child's set) THAT IS JUST LIKE THIS ONE (pointing to your circle).

Proceed with square, triangle, rectangle.

3. Scoring System

Matching

		Correct Response (✓)	Incorrect Response (✓)	No Response (✓)
1	Circle			
2	Square			
3	Triangle			
4	Rectangle			

B. Naming

1. Materials

Two sets of geometric shapes.

2. Directions

Leave shapes set up as they were for matching.

CAN YOU TELL ME THE NAMES OF THE SHAPES?
WHAT IS THIS? (pointing to square in the child's set)
AND THIS? (pointing to triangle in the child's set)
THIS? (pointing to rectangle in the child's set)
WHAT IS THIS? (pointing to circle in the child's set)

3. Scoring System

Naming

		Correct Response (✓)	Incorrect Response (✓)	No Response (✓)
1	Square			
2	Triangle			
3	Rectangle			
4	Circle			

C. Identifying

1. Materials

Two sets of geometric shapes.

2. Directions

Leave shapes set up as they were for matching and naming.

WOULD YOU GIVE ME THE TRIANGLE SHAPE?

WOULD YOU GIVE ME THE RECTANGLE SHAPE?

NOW, THE CIRCLE.

AND NOW THE SQUARE.

AND THE L-SHAPE.

3. Scoring System

Identifying

		Correct Response (✓)	Incorrect Response (✓)	No Response (✓)
1	Triangle			
2	Rectangle			
3	Circle			
4	Square			

VI PAIRING (First Grade)

1. Materials

Workbook sheets for each child, pencil for child.

2. Directions

HERE IS A PAPER (page 1) WITH A SET OF PICTURES ON ONE SIDE OF THE LINE.

Point to set on child's left side of the paper.

DO YOU SEE THE LINE? (Wait for affirmative response.)

AND HERE IS ANOTHER SET OF PICTURES ON THE OTHER SIDE OF THE LINE.

Point to set on child's right side of paper.

I WANT YOU TO PAIR THE MEMBERS OF THIS SET (pointing to drawings on child's left) WITH THE MEMBERS OF THIS SET (pointing to drawings on the child's right side of the line). Hand child the pencil.

If no response, say:

USE THE PENCIL TO PAIR THE MEMBERS.

If child pairs only one member in each set and then stops, say:

PAIR THE OTHER MEMBERS.

When the child has finished, say:

TURN THE PAGE AND DO THE SAME WITH THE SETS ON THIS PAGE (pointing to page 2). PAIR THE MEMBERS OF THESE SETS (pointing to sets on left and right of the page).

When child has finished page 2, say:

HERE IS ANOTHER PAGE (pointing to page 3).
PAIR THE MEMBERS OF THE SETS.

When child has finished page 3, say:

AND ONE MORE (pointing to page 4).

PAIR THE MEMBERS OF THE SETS.

In scoring this section, comment whether child paired similar members first. Also note if child stops after pairing only one pair of members and must be told to pair other members.

3. Scoring System

Pairing

Paired correctly	1	2	3	4
Attempted, Incorrect (circle)	1	2	3	4
No attempt (circle)	1	2	3	4

VII EQUIVALENT SETS (Kindergarten and First Grade)

1. Materials

   6 number cards, 20 buttons, 1 sheet of construction paper.

2. Directions

   Heap the buttons to the child's left. Place the sheet of construction paper in front of him.

   I AM GOING TO SHOW YOU SOME CARDS WITH BUTTONS OR DRAWINGS ON THEM.

   Show the child Card 1. Place it above his sheet of paper, and say:

   ON THIS SHEET (point to his construction paper) MAKE A SET, WITH THE BUTTONS, WHICH IS EQUIVALENT TO THIS SET (pointing to the number card).

   If child does not respond, say:

   MAKE A SET WITH YOUR BUTTONS ON THIS SHEET (point to construction paper) THAT HAS THE SAME NUMBER OF MEMBERS AS MY SET HAS (point to your number card).

   Pause after child finished, and remove buttons from his paper to the side of the table each time. Continue with the number cards in the order and position as marked on the back of each card.

   Have on the table only the number card for which the child is constructing an equivalent set. Keep all other number cards off of the table.

   Stop after the child has made two consecutive errors in constructing sets.

3. Scoring System

Equivalent Sets

(Check two columns for this task.)

Card	Correct (✓)	Incorrect (✓)	Equivalent Set formed by		
			(✓) Copying Pattern	(✓) Counting	(✓) Other (Explain)
I					
II					
III					
IV					
V					
VI					

VIII COUNTING (Kindergarten and First Grade)

A. Counting Objects (includes assessment for Marking Number Symbols)

1. Materials

   50 buttons, 4 boxes, 4 box tops, pad of paper, crayon.

2. Directions

   LET'S PUT SOME BUTTONS IN THESE BOXES.

   Place a heap of buttons in front of the child and give him a box.

   WILL YOU PUT TWO BUTTONS IN THE BOX? I WILL MARK A "2" ON THIS PAPER.

   Mark "2" on the paper. Show the child, and place it standing in the box with the 2 buttons.

   NOW WE WILL KNOW HOW MANY BUTTONS ARE IN IT.

   Move this box to the child's left. Place another box in front of the child, and say:

   WOULD YOU PUT THREE BUTTONS IN THE BOX? (Pause) WOULD YOU LIKE TO MARK A "3" ON THIS PAPER?

   Give child crayon and card if he is willing to try. If not, mark it yourself. Note in comments what numerals child attempted.

   Continue in the order listed on the scoring sheets.

   Stop after the child has made two consecutive errors in counting.

   Remove materials from table before beginning next section.

3. Scoring System

Counting Buttons

No. Asked	Correct (✓)	Incorrect (✓)
3		
5		
4		
6		
8		
7		
9		

Marking Number Symbols

Marked correctly (circle)	3	5	4	6	8	7	9
No attempt (circle)	3	5	4	6	8	7	9
Attempted, Incorrect (circle)	3	5	4	6	8	7	9

B. Counting Members of a Given Set

1. Materials

   Eight cards with drawings.

2. Directions

   Place card in front of the child, and say:

   HOW MANY MEMBERS ARE THERE IN THIS SET?

   If no response, say:

   HOW MANY DRAWINGS ARE ON THIS CARD?

   Continue in the order and with the position of the card as marked on the back of each card.

   Stop after the child has made two consecutive errors in counting.

3. Scoring System

Counting Members of a Given Set

(Circle each card number counted correctly)

Card Number	1	2	3	4	5	6	7	8

C. Rote Counting

1. Materials

   None required.

2. Directions

   WILL YOU COUNT FOR ME?

   Pause, if no response, say:

   I'LL START AND THEN YOU GO ON. ONE, TWO.

   Pause. If still no response, say:

   ONE. WHAT COMES NEXT?

   Stop the child when he reaches "100".

3. Scoring System

Rote Counting

(Circle omits; × last number counted)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100					

D. Rote Counting by Tens (First Grade)

1. Materials

None required.

2. Directions

WILL YOU COUNT BY TENS FOR ME?

Pause, if no response, say:

I'LL START AND THEN YOU GO ON. TEN, TWENTY.

Pause. If still no response, say:

TEN. WHAT COMES NEXT?

3. Scoring System

Rote Counting by Tens

(Circle omits; × last number)

10	20	30	40	50	60	70	80	90	100
110	120	130	140	150	160	170	180	190	200

IX NUMBER SYMBOLS (Kindergarten and First Grade)

A. Naming (First Grade)

1. Materials

Set of numeral cards labeled: 5, 8, 9, 11, 14, 16, 19, 23, 32, 38, 40, 41, 80.

2. Directions

I HAVE SOME CARDS HERE.

Show the set of cards so that he can see the numerals.

THE CARDS HAVE NUMERALS ON THEM. THIS ONE HAS A 5 ON IT. WHEN I SHOW YOU A CARD, YOU TELL ME WHAT NUMERAL IS ON IT.

Show pupil the next card, and say:

WHAT NUMERAL IS THIS?

Continue in the order marked on the scoring sheet. Stop after two consecutive errors.

3. Scoring System

Recognition of Number Symbols - Naming

Named Correctly (circle)	8	11	9	16	19	14
	40	23	38	41	32	80

B. Identifying

1. Materials

Kindergarten: ten envelopes with buttons inside and numerals on them.

First Grade: two sets of numeral cards.

2. Directions

a. Kindergarten

I HAVE SOME ENVELOPES HERE.

Show envelope so that child can see numeral.

THIS ONE HAS SOME BUTTONS IN IT. THIS (point to the numeral on the envelope) TELLS US HOW MANY BUTTONS ARE INSIDE. THIS ONE HAS A "2" ON IT. IT HAS TWO BUTTONS IN IT.

Place envelopes (marked 0-5) randomly in front of child with all number symbols facing the child.

GIVE ME THE ONE THAT HAS 3 BUTTONS INSIDE.

Continue, asking for 1 and then 4.

If, after these trials, it is evident that the pupil cannot recognize the symbols, do not proceed. But, if child has been successful for these three trials, then randomly place remaining envelopes (marked 6, 7, 8 and 9) on the table with the other envelopes and proceed:

GIVE ME THE ONE WITH 5 BUTTONS INSIDE.

Continue in the order marked on the scoring sheet.

b. First Grade

I AM GOING TO SPREAD SOME NUMERAL CARDS ON THE TABLE.

Randomly spread Part A of Set 2, (numeral cards 7, 9, 11, 26, 8), on the table in front of the child so that all numerals can be clearly seen, and say:

GIVE ME THE CARD THAT HAS 7 ON IT.

Continue, asking consecutively for 9, 11, 26, 8. If, after these trials, it is clear that the child cannot recognize the symbols, do not proceed. If child has succeeded on at least three, randomly spread Part B of Set 2, (numeral cards 16, 62, 27, 30, 51), on the table with the remaining cards of Part A and proceed:

GIVE ME THE CARD THAT HAS 16 ON IT.

Continue in the order marked on the scoring sheet. Stop after two consecutive errors.

3. Scoring System

a. Recognition of Number Symbols - Identifying (Kindergarten)

Recognized (circle) 3 1 4 0 5 8 7 9

b. Recognition of Number Symbols - Identifying (First Grade)

Identified Correctly (circle) 7 9 11 26 8
16 62 27 30 51

C. Marking Number Symbols

1. Materials

a. 50 buttons, 4 boxes, 4 box tops, pad of paper, crayon.

b. Extension of task for first grade: seven bundles of ten paste sticks, ten single paste sticks, crayon, pad of paper.

2. Directions

This assessment is included in either Counting Buttons or in the Place Value portion of the inventory. Directions pertinent to this task are repeated here for convenience.

a. Initial inventory for both kindergarten and first grade (Counting Buttons).

LET'S PUT SOME BUTTONS IN THESE BOXES.

Place a heap of buttons in front of the child and give him a box.

WILL YOU PUT *TWO* BUTTONS IN THE BOX? I WILL MARK A "2" ON THIS PAPER.

Mark "2" on the paper. Show the child, and place it standing in the box with the 2 buttons.

NOW WE WILL KNOW HOW MANY BUTTONS ARE IN IT.

Move this box to the child's left. Place another box in front of the child, and say:

WOULD YOU PUT *THREE* BUTTONS IN THE BOX? (Pause) WOULD YOU LIKE TO MARK A "3" ON THIS PAPER?

Give child crayon and paper if he is willing to try. If not, mark it yourself. Note in comments what numerals child attempted.

Continue in the *order listed on the scoring sheets*.

Stop after the child has made two consecutive errors in counting. Remove materials from table before beginning next section.

b. Extension in final inventory for first grade only.

Place Value - Forming

Place the sticks in front of the child: the seven bundles of ten in one heap toward the child's left and the ten single sticks in another heap to child's right, and say:

USING THE BUNDLES OF TEN AND THE SINGLE STICKS, MAKE A SET OF SIXTEEN STICKS.

Marking Number Symbols

When this task is complete, give child the crayon and pad, and say:

WRITE THE NUMERAL 16 ON THIS PAD.

Replace the sticks in their correct heaps, and repeat in the order listed on the scoring sheet.

3. Scoring System

Marking Number Symbols

a. Initial inventory

Marked correctly (circle)	3	5	4	6	8	7	9
No attempt (circle)	3	5	4	6	8	7	9
Attempted, Incorrect (circle)	3	5	4	6	8	7	9

b. Extension in final inventory

Marked Correctly (circle)	16	5	30	23	18	32	27	50	42
Attempted, Incorrect (circle)	16	5	30	23	18	32	27	50	42
No attempt (circle)	16	5	30	23	18	32	27	50	42

X PLACE VALUE (First Grade)

A. Naming

1. Materials

Seven bundles of ten paste sticks in each bundle, ten single paste sticks.

2. Directions

Arrange the seven bundles of 10 paste sticks in front of you, and say:

EACH OF THESE BUNDLES HAS TEN PASTE STICKS.

Place two bundles of sticks in front of child, and say:

HOW MANY STICKS DO YOU HAVE?

If child says two tens, record this in comments column, and say:

DO YOU KNOW ANOTHER NAME FOR TWO TENS?

Remove these bundles. Place five bundles of sticks in front of child, and say:

HOW MANY STICKS DO YOU HAVE?

If child says five tens, record this in comments column, and say:

DO YOU KNOW ANOTHER NAME FOR FIVE TENS?

Repeat for six bundles and three bundles and then proceed as follows: Place three bundles and five single sticks in front of child, and say:

HOW MANY STICKS DO YOU HAVE?

If child says three tens and 5 more or something equivalent, record in comments column, and say:

DO YOU KNOW ANOTHER NAME FOR THIS?

Remove sticks and repeat with:

5 bundles and 7
2 bundles and 4
4 bundles and 7
1 bundle and 9
7 bundles and 5.

3. Scoring System

Place Value - Naming

Named Correctly (circle) 20 50 60 30 35 57 24 47 19 75

B. Forming

1. Materials

Seven bundles of ten paste sticks in each bundle, ten single paste sticks, pad of paper, crayon.

2. Directions

Place the sticks in front of the child: the seven bundles of ten in one heap toward the child's left and the ten single sticks in another heap to child's right, and say:

USING THE BUNDLE OF TEN AND THE SINGLE STICKS, MAKE A SET OF SIXTEEN STICKS.

When this task is complete, give child the crayon and pad, and say:

WRITE THE NUMERAL 16 ON THIS PAD.

Replace the sticks in their correct heaps, and repeat in the order listed on the scoring sheets.

3. Scoring System

Place Value - Forming

Formed correctly (circle) 16 5 30 23 18 32 27 50 42

XI ORDINAL NUMBER (Kindergarten and First Grade)

1. Materials

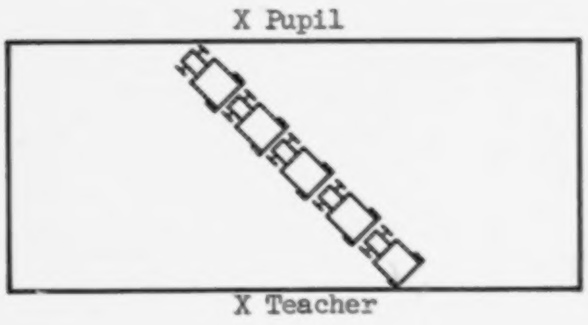
5 trucks, 25 marbles.

2. Directions

a. Part I

HERE ARE SOME TRUCKS AND SOME MARBLES. I AM GOING TO LINE UP THE TRUCKS LIKE THIS.

Line up trucks with cabs of trucks at an angle toward pupil's right.



Hand child a marble. Say:

WOULD YOU PUT THIS MARBLE IN THE FIRST TRUCK?

WOULD YOU PUT THIS MARBLE IN THE FOURTH TRUCK?

Then say:

WOULD YOU PUT THIS MARBLE IN THE TRUCK?
THIRD
FIFTH
FIRST
LAST
SECOND
FOURTH
MIDDLE

b. Part II

When Part I is completed, have child help in placing more marbles in the trucks so that there are three marbles in each truck.

GIVE ME ONE OF THE MARBLES FROM THE THIRD TRUCK.

NOW GIVE ME ONE FROM THE FIFTH TRUCK.

AND ONE FROM THE SECOND TRUCK.

FIFTH
FOURTH
SECOND
LAST
FIRST
THIRD
FIFTH
MIDDLE

3. Scoring System

Ordinal Number

Part I

Order	Correct (✓)	Incorrect (✓)
First		
Fourth		
Third		
Fifth		
First		
Last		
Second		
Fourth		
Middle		

Part II

Order	Correct (✓)	Incorrect (✓)
Second		
Fifth		
Fourth		
Second		
Last		
First		
Third		
Fifth		
Middle		

XII ORDERING AND CLASSIFYING (Kindergarten and First Grade)

1. Materials

   3 sets of geometric shapes.

2. Directions

a. Set I

Spread out the geometric shapes of Set I randomly in front of the child so that all are visible.

HERE ARE SOME SHAPES OR REGIONS. YOU FIND ALL THE TRIANGLES, AND PUT THEM HERE (pointing to the child's right).

Count the number the child finds and record. If child does not respond, say:

SHOW ME A TRIANGLE. (Pause) NOW PUT ALL THE TRIANGLES OVER HERE (pointing to the child's right).

If child still cannot identify a triangle, point to one of the middle-size triangles, and say:

THAT IS A TRIANGLE.

Be certain to write down in comments on the score sheet if it is necessary for you to identify the triangle for the child.

Count the number the child finds and record.

Add any triangles the child has overlooked to his set of triangles. If child has included shapes other than triangles in his set, note number and shape of these in comments on the score sheet.

Remove all the shapes except the four triangles from the table, and say:

CAN YOU PUT THESE (pointing to triangles) IN A LINE SO THAT THEY GO FROM THE SMALLEST TO THE LARGEST?

GIVE ME THE SMALLEST TRIANGLE.

b. Set II

Spread out the geometric shapes of Set II randomly in front of the child so that all are visible.

HERE ARE SOME OTHER SHAPES. HAND ME THE SHAPES THAT ARE CIRCLES AND YELLOW.

Be certain to write down in comments if other shapes were included. Note the shape and color of noncircular shapes included in the set. Note if other colored circles were included.

Count the number of yellow circles child finds and record. Add any yellow circles the child has overlooked. Remove all shapes except the four yellow circles from the table, and say:

CAN YOU PUT THESE (pointing to the circles) IN A LINE SO THAT THEY GO FROM THE SMALLEST TO THE LARGEST?

GIVE ME THE SMALLEST CIRCLE.

c. Set III

Spread out the shapes of Set III randomly in front of the child so that all are visible.

HERE ARE SOME OTHER SHAPES OR REGIONS.

THERE ARE FOUR DIFFERENT SHAPES IN THE SET. (Point to one of each shape.)

GIVE ME THE SMALLEST ONE OF EACH DIFFERENT SHAPE.

If child does not respond, say:

MAKE A SEPARATE PILE FOR EACH SHAPE. (Point again to one of each shape.)

Be certain to note in comments if it is necessary to tell the child to do this.

Note in comments if error was made, which smallest shape was omitted or if any larger ones were included.

3. Scoring System

Ordering and Classifying

a. Set I

No. of triangles sorted (circle)   0   1   2   3   4

Ordered Triangles (check appropriate box)

	Correct	Incorrect
Smallest to largest		
Largest to smallest		

Handed smallest triangle Yes____ No ____

b. Set II

No. of Circles and Yellow sorted 0 1 2 3 4
(circle)

Ordered Circles and Yellow
(check appropriate box)

	Correct	Incorrect
Smallest to largest		
Largest to smallest		

Handed smallest circle Yes____ No____

c. Set III

No. of SMALLEST members sorted 0 1 2 3 4
(circle)

If Not 4 then error was ☐ omitted shape

☐ larger shape

Appendix D

Interitem Reliability

The Cronbach α was calculated for the total population as a measure of interitem reliability. The formula for this ratio, developed by Lee J. Cronbach, embodies the Kuder-Richardson coefficient of equivalence as a special case. According to Cronbach,[30] α "is the average of all possible split-half coefficients for a given test".

Kindergarten Items

Item	Initial	Midyear	Final
Object Recognition	0.536		
Photograph Recognition	0.225		
Drawing Recognition	0.070		
Vocabulary		0.713	
Visual Memory - Objects	0.498		0.440
Visual Memory - Pictures			0.452
Matching Colors	0.706		
Naming Colors	0.846		0.740
Identifying Colors	0.872		0.775
Matching Geometric Shapes		0.481	
Naming Geometric Shapes		0.758	0.632
Identifying Geometric Shapes		0.689	0.640
Equivalent Sets		0.778	
Counting Buttons	0.889	0.886	0.810
Counting Members of a Set		0.883	0.739
Identifying Number Symbols	0.899		0.850
Marking Number Symbols	0.814		0.811
Ordinal Numbers - Part I			0.825
Ordinal Numbers - Part II			0.871

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[30] Cronbach, Lee J. Coefficient Alpha and the Internal Structure of Tests, Psychometrika, v. 16, no. 3, September 1951, pp. 297-334.

First Grade Items

Item	Initial	Midyear	Final
Object Recognition	0.381		
Photograph Recognition	0.092		
Drawing Recognition	-0.013		
Vocabulary		0.726	
Visual Memory - Objects	0.369		0.165
Visual Memory - Pictures			0.349
Matching Colors	0.486		
Naming Colors	0.845		0.798
Identifying Colors	0.877		
Matching Geometric Shapes		0.762	
Naming Geometric Shapes		0.638	0.481
Identifying Geometric Shapes		0.578	0.577
Pairing		0.834	
Equivalent Sets		0.720	
Counting Buttons	0.881	0.899	
Counting Members of a Set		0.786	0.726
Identifying Number Symbols	0.914	0.851	0.939
Naming Number Symbols			0.903
Marking Number Symbols	0.838	0.803	0.896
Place Value - Naming			0.924
Place Value - Forming			0.915
Ordinal Numbers - Part I			0.845
Ordinal Numbers - Part II			0.877

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